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SCIENCE AND MORAL REARMAMENT

SINCE the international crisis of last September public attention has been directed time and again in letters to the Press and in other ways to the need for rearmament in the moral sphere. The movement and the interest in it have undoubtedly sprung from a feeling that a critical point has been reached in the history of our civilization, and that there is danger of disaster unless certain changes in the psychology of nations can be brought about.

The movement was by no means confined to Great Britain. Early in June this year a National Meeting for Moral Rearmament was held in Washington to which addresses were sent, not only by prominent American citizens, but also by members of the House of Lords and of the House of Commons, by British Labour leaders, from Northern Ireland, from Scotland, and from a number of European countries including Switzerland, Holland, Norway, as well as from a number of political and cultural leaders in the Balkans. On this occasion the message from ex-President Hoover was particularly urgent. "The world has come out of confusion before," he wrote, "because some men and women stood solid. . . . They stood firm because they individually held to certain principles of life, of morals, and spiritual values. These are the simple concepts of truth, justice, tolerance, mercy, and respect for the dignity of the common man." The message from Mr. Cordell Hull, the Secretary of State, struck the same note of urgency: "Here in the post-war period there has been a general lowering of standards of conduct—moral, political, social, and economic. International morality has seldom been at a lower ebb. The time is ripe and the need is urgent for a renewal and restoration of the former high standard of conduct of both individuals and governments."

A month later, a World Assembly for Moral Rearmament in the Hollywood Bowl, California, was attended by 30,000 people, and it is estimated that 10,000 were turned away. Twenty-five nations sent representatives, and there was a joint meeting for Chinese and Japanese. Once more a remarkable series of addresses was sent. A manifesto signed by 60,000 British citizens, and messages from artists, labour leaders, educationists, and men of science were among those received. A message signed by seventeen distinguished British men of science rans as follows:

"All who are engaged in the increase of Natural Science are necessarily interested in Moral Rearmament. The effect of the new knowledge which is gained by the study of Nature depends upon the spirit in which it is received and used. Men of good will can make a glorious blessing of it, if they act with wisdom and skill; but ill will and folly can draw from it a curse. Most earnestly, therefore, do we pray as scientists for the success of your coming conference."

This manifesto is to be warmly welcomed as evidence that men of science are alive to the supreme importance of moral issues. We have in these columns frequently directed attention to the lag which exists between the progress of scientific investigation and the ethical advance of mankind. Scientific advance has been more rapid than ethical; indeed there is, as Mr. Cordell Hull said, evidence of actual ethical decline. It is on this account encouraging to note that men of science are not disposed to ignore ethical problems on the specious ground that these lie outside their province. The ethical advance of mankind badly needs speeding up, and men of science are evidently prepared to take their part in applying the necessary stimulus.

We hear much of the increasing specialism of

modern scientific study; yet men of science are citizens and human beings as well as specialists, and as such it is incumbent upon them to seek to put an end to the present confusion. Their duty in this respect is all the clearer on account of the general respect in which their pronouncements are held. No other class of intellectual guide enjoys the same public confidence; neither journalists, bishops, literary men, educationists, nor professional philosophers have the ear of the people to the same extent. Furthermore, men of science are only too well aware that the future development of science is inextricably bound up with the survival of certain moral standards and values, such as disinterested love of truth, toleration for new opinions, and so on. If scientific researches are ever subordinated to utilitarian or propagandist ends, the fate of science will be sealed, for in the cultural sphere segregation is impossible.

It may be that the public is entitled to look to the men of science for something even more fundamental than ethical guidance. Mr. Hoover's message spoke of salvation coming from those who "individually hold to certain principles of life, of morals, and spiritual values". Likewise a message from British educationists to the World Assembly stressed the need to equip people with "simple and absolute moral standards". But principles and standards logically rest upon convictions; they fit into a framework of ideas which form an organic whole. But the trouble now is that this framework has been loosened and some parts of it are missing. Is it possible for men of science to tighten up and repair this framework, or if that is no longer possible, to provide us with a new one? Men of science were in no small degree responsible for weakening the traditional framework; can they not now turn from a destructive to a creative role? It would be a thousand pities if their ever-increasing specialism caused men of science to eschew fundamental problems altogether, and to become mere "intelligences within high walls".

Lately, we have received from Prof. T. D. A. Cockerell, of the University of Colorado, a communication which shows that the mind of at least one man of science is trying to think out some of the implications of new knowledge. "It comes to this," he writes, "mankind has evolved, with all his wonderful powers, and with his emerging sense of right and wrong, and of the value of personality. Especially does it seem incredible to us that the attributes of the human mind should be uniquely the property of a little organic slime on an infinitesimally small fragment of the matter in the universe. Hence we postulate a greater mind, and wonder about it, as a couple of cells in the body might (were they suitably endowed) wonder whether they were part of something greater, without being able to reach a decision that was capable of demonstration. I cannot bring myself to believe that the human mind is a purely ephemeral and essentially quite unimportant phenomenon in a vast inanimate universe."

Thoughts such as these must have occurred to many scientific workers in their speculative moments, and it would be a pity if all such ideas were dismissed as idle and irrelevant to the work in hand. There is no good reason why men of science should place themselves under a self-denying ordinance whereby all philosophical speculation is taboo. Now that academic metaphysics has become as technical a subject as the higher mathematics, the public have need of a philosophy which conveys some meaning to their minds. There is no call for men of science to dogmatize in the philosophic sphere; which they are not likely to do, being chary of dogmatism in their own. All that the public requires of them is some measure of guidance as to the nature of the universe of which we form a part.

In one respect, as Prof. Levy has pointed out, the man of science has the advantage of the philosopher. Whereas the latter only professes to tell us what the world means, the former tells us what can be done with it. His outlook is therefore practical; and on this account it may actually prove that his philosophical speculations, however unacademic, are nearer the mark than those of his metaphysical colleague. There is much to be said for the view that the human intellect is a tool devised for dealing with our material environment, and is most reliable when it is thus engaged. Divorced from action on the environment, the human intellect turns in on itself and functions as uselessly as a squirrel in a cage, or as the engine of a car before the clutch has been let in.

At the present time there is too much defeatism about with regard to science. Its potentialities have become so great that people are afraid of it. Such defeatism would have small chance of spreading if men of science would take the public into their confidence, and tell them what science can do for men of good will. Those who understand science best know that what we are suffering from is not too much of it but too little.

THE STUDY OF BRITISH VEGETATION

The British Islands and their Vegetation
By A. G. Tansley. Pp. xxxviii + 930 + 162 plates. (Cambridge: At the University Press, 1939.) 45*s.* net.

THE subject of plant ecology, like the science of which it forms a part, began as a purely descriptive study concerned with the natural or semi-natural aggregates of diverse species that constitute plant communities, instead of with the conceptual aggregates of similar individuals that are the concern of the taxonomist. Moreover, in its inception the study of plant communities was mainly floristic. The pioneers in Great Britain were the brothers Robert and W. G. Smith and it was at the latter's house in 1904 that the Central Committee for the Survey and Study of British Vegetation had its inception. This gave place to the British Vegetation Committee and this in turn, nine years later, was replaced by the British Ecological Society with the *Journal of Ecology* as its official publication.

No one has done more to promote the study of phytogeography in Great Britain than the author of the work under review. As editor of the *Journal of Ecology* for more than two decades, Prof. Tansley did more than any other single person to organize and stimulate interest in descriptive ecology, and the bulky volume before us is a fitting culmination to the author's work in this field.

The British Vegetation Committee consisted of a small group of enthusiasts which, besides W. G. Smith, included C. E. Moss, F. W. Oliver, A. G. Tansley and T. W. Woodhead. In 1911 Tansley organized an excursion in Great Britain for the benefit of foreign men of science, and with the help of other members of the Committee prepared the handbook entitled "Types of British Vegetation". The book was definitely static in its method of presentation, although F. W. Oliver's investigations on maritime habitats had already given an impetus to the dynamic approach to the study of vegetation.

"Types of British Vegetation", which Tansley edited, at once achieved popularity. It was the only publication then available on the subject, it was well illustrated, handy in size and very low in price. Unfortunately the edition was quite small and the book soon became a second-hand rarity. Now, after the lapse of more than a quarter of a century, Prof. Tansley has provided us with another work, also essentially descriptive in character, but the scope of which has been greatly extended beyond that of the volume it replaces. The floristic aspect is still prominent, and extensive lists of species are furnished; but the structure of the communities and their successional relations receive much fuller treatment. It is perhaps inevitable that the present work is neither small nor inexpensive.

As the author himself emphasizes, the work is largely a compilation of abstracts from the published literature and as a consequence there are certain gaps which one would like to have seen filled. The interesting vegetation of the limestone pavements, for example, has similar meagre treatment as twenty-eight years ago. We regret, too, the omission of the vegetation of arable land and disturbed soil, especially as there is available a not inconsiderable, though admittedly rather scattered, literature on the topic. For, despite their semi-artificial character, such have an important bearing on the early stages of succession.

The first section of the book treats of the environmental complex, the physical features, geology, climate, soil and biotic conditions. The chapter on soil is somewhat academic and might with advantage have been more directly related to the structure of soils as they occur in Great Britain. The attempt to place British soils into systems of classification devised for regions of more differentiated climates is not without its dangers for, as has been emphasized by Glinka, the soils of Britain can be regarded as aclimatic and, as Sir John Russell has pointed out, cannot readily be fitted into existing schemes of classification. The section on prehistory is a useful summary of the data furnished mainly by the study of sub-fossil remains, especially of pollen distribution.

Part 3 treats of the nature and classification of vegetation types, whilst Parts 4–9, representing nearly three-quarters of the entire work, are devoted to the detailed description of the various categories of plant community. The method adopted is an approach to the type system, summaries being furnished of the published accounts of particular examples. Partly owing to the nature of the areas which have been investigated, the picture presented is sometimes a rather partial one. This is very noticeable in the account of the vegetation of ponds and is sufficiently emphasized by the entire absence, from among the species cited in this connexion, of such characteristic plants as *Alopecurus geniculatus* and *Bidens cernua*, or of any mention of the Juncetum dominated by *Juncus inflexus*, so characteristic of the margins of ponds in the stiffer and more basic soils.

The work as a whole, which is profusely illustrated with half-tone reproductions, many of which are of great merit and technical excellence, is not merely a valuable survey and a monument of what has been accomplished during the past thirty years, much of it under the stimulus of Tansley's initiative, but also an indication of the gaps that still require to be filled. Whilst there still remains much work that can be carried out in descriptive plant ecology in Great Britain, it is probably true to say that such studies, though they may reveal new manifestations, are unlikely to yield new principles, and in this sense the work before us may be said to mark the closing of the purely descriptive phase of the study of British vegetation. Future progress lies rather in the direction of causal ecology, of the study of the biological relations of species, and in the application of the principles of physiology and the factors of competition to the elucidation of the problems of plant and animal life under natural and semi-natural conditions. But, with the advent of such knowledge, many segregations and doubtless new syntheses of communities will become necessary before we can attain to a classification of vegetation types that will adumbrate both the great diversity of organization and the similitude of environmental factors.

E. J. SALISBURY.

KEPLER'S APPROACH TO OPTICS

Johannes Kepler Gesammelte Werke
Herausgegeben im Auftrag der Deutschen Forschungsgemeinschaft und der Bayerischen Akademie der Wissenschaften. Unter der Leitung von Walther von Dyck und Max Caspar. Band 2: Astronomiæ Pars Optica. Herausgegeben von Franz Hammer. Pp. 466. (München: C. H. Beck, 1939.) 9 gold marks.

WITH the appearance of the second volume of the new edition of Kepler's works the first three volumes are now available, the third containing the "Astronomia Nova" having been issued first in order of date. It is curious that the three already exhibit the complex personality of Kepler in a violently contrasted way. In the first, the mystic element is predominant, and that is hard to reconcile with a truly scientific spirit. The second reveals the impatience of a sanguine temperament, which is not easily compatible with a philosophic outlook. The third, equally the product of those active years which followed the death of Tycho Brahe, reflects an assured serenity, when insight and resource never fail and every difficulty is met and overcome with untiring industry. No voluminous writer can be expected to produce a succession of masterpieces of the highest order, but in the inequality of his work it would be hard to find a parallel to Kepler.

The first words of the lengthy title are "Ad Vitellionem Paralipomena", and they cover the contents of the first part of the book now reprinted. The sources of Kepler's knowledge of optics may be briefly indicated. The most important contributions to the subject by the ancient world were contained in works attributed to Euclid and Ptolemy. These, sharing the common fate of such books, were lost to Europe in the following age, but were preserved in an Arabic form. The study was thus kept alive until the Arabian astronomer known as Alhazen (d. 1038) wrote a text-book on it. It was not until the thirteenth century that interest in optics reappeared in Europe. A text-book, "Perspective", based very closely on the work of Alhazen, was then written by a Pole (or Thuringian), Witelo (the Vitellio of Kepler). A slighter but similar work, a "Perspectiva", was also written in the same century by John Peckham, who became Archbishop of Canterbury (referred to by Kepler under the name Pisanus). It was these books which were printed in the sixteenth century, and that of Witelo was the main source of Kepler's knowledge of the subject. He refers also to the work of della Porta, but the earlier and more important work of Maurolycus in Italy was not accessible to him.

The present editor is very careful to insist on these limitations to the knowledge inherited by Kepler from his predecessors. They may be accepted. But it does not follow that the knowledge of optics, practically that of the year 1000, was equally circumscribed in the world at large. Apart from the Italian school, the craftsmanship of the Dutch lensmakers may be recalled for two reasons. By universal tradition it was from Holland that Galileo derived the suggestion for his telescope. It is also scarcely necessary to look further for the inspiration which in turn guided Snell, Descartes and Huygens in optical research.

But in England also, the study of optics had not been altogether neglected. Already in the thirteenth century Roger Bacon had done work of a very different order from the compilations made by his contemporaries. That work was transmitted in manuscript form to Leonard and Thomas Digges and John Dee in the sixteenth century.

These men formed a group working independently of any Continental tradition, and yet not isolated, since they were known to Tycho Brahe, as Harriot a few years later was known to Kepler. Thus research in optics had been kept alive to such an extent that Harriot was able to supply himself and his friends with telescopes; but it remains true that the progress made had taken a practical shape and the results had not been published in the printed form. In consequence, some things which Kepler claimed as new were not so original as he supposed.

The book follows a most comprehensive plan. It includes geometrical optics, physiological optics, and in the second section deals with a variety of astronomical matters such as eclipses and problems of parallax which would now be considered alien to the main subject. In the circumstances of the time, there was plainly an opening for a new work on geometrical optics, and the needs of astronomy prompted a careful consideration of the subject, more particularly for the investigation of astronomical refraction. With these motives and with a certain amount of material in hand, Kepler started on his task early in 1603. He seems to have worked to a self-imposed time-table. The work was to be finished by the end of the year and to be published in the following spring. It did appear in the following autumn, and in view of modern conditions, there seems little reason for complaint on the score of delay in the production of a large volume.

The project may have been justifiably optimistic or foolishly arrogant, according to the point of view. In any event, the difficulties of the task became more and more apparent, and as they grew Kepler became more impatient. This is shown in his correspondence and it is abundantly clear from internal evidence. Ideas are started and carried to no logical conclusion. Passages which should have been re-written were merely amended in a hasty way. But Kepler persisted and the book was finished within the year. He knew the eager and uncritical public for whom he catered. But his own interest in the subject was probably waning.

For this, two reasons may be readily conjectured. The first one and the more important excuse for his impatience was the urgent call of that other work which was the true mission of his life. Hence the adherence to a time limit. But he must also have become aware that the conditions were unpropitious for the production of a "Markstein zweiter [or any other] Ordnung". What the science of optics at that time plainly needed was a foundation in accurate experiment. This was entirely lacking. Now Kepler was himself no experimental physicist, and he had no source from which he could draw what was necessary. The experimental data at his command were incredibly slight, and he must have become conscious of the fact.

This applies in particular to the capital problem of the time, the determination of the law of refraction. Kepler's formula is

$$\alpha - \beta = k \alpha \sec \beta,$$

where α is the angle of incidence, β the angle of refraction. With $(1 - k)^{-1} = n$, this gives results similar to the law

$$\sin \alpha = n \sin \beta$$

for the smaller refractions. The constant k for air-water is based on the assumed values $\alpha = 80°$, $\beta = 50°$ (more than 2° in error). As the formula is really empirical, being founded on the flimsiest physical argument, it seems strange that a form so inconvenient for the derivation of β from α should have been adopted. The relation also seems inconsistent with the most obvious principle of optics, the reversibility of the ray.

Passing on to the problem of astronomical refraction, Kepler was in a position of complete ignorance as to the nature of the atmosphere. He assumed that it was homogeneous and ultimately fixed its height at about 4 km. Tycho Brahe had left three separate tables of refraction for the sun, moon and stars, and Kepler found it impossible to represent the solar table in spite of repeated trials. He therefore resorted to the original observations of Tycho and found material which removed the difficulty. Thus he succeeded in constructing a table of refractions which has been found superior to those of Tycho. But the advance must be regarded as belonging to astronomy rather than to optics.

The present editor's analysis and notes are of great value. If a rather lower estimate has been placed here on the intrinsic importance of Kepler's book, it is in the belief that the time was not ripe for the production of a major work. It was the threshold of a period of great advances in optics, but for the moment the knowledge which could only come from experiment was lacking. When Harriot supplied a list of angles of refraction with angle of incidence 30° for no less than fourteen media, with the corresponding specific gravities, and pointed out that there was no direct relation between refractivities and densities, quite characteristically Kepler argued against the evidence. He might have learnt more about optics from Harriot, as he might have learnt something about the sidereal universe from Digges, and Wallis was not far wrong in his general thesis that early English science had not met with due recognition on the Continent.

H. C. PLUMMER.

HISTORY OF MEDICINE

(1) Early Medieval Medicine

With Special Reference to France and Chartres. By Prof. Loren C. MacKinney. (Publications of the Institute of the History of Medicine, the Johns Hopkins University. Third Series: The Hideyo Noguchi Lectures, Vol. 3.) Pp. iii+247 (9 plates). (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1937.) 12*s*. 6*d*. net.

(2) Medicina aborigen americana

Por el Dr. Ramon Pardal. (Humanior, Biblioteca del Americanista Moderno, Sección C: Patrimonio cultural indiano, Tomo 3.) Pp. 377+6 plates. (Buenos Aires: Jose Anesi, n.d.) n.p.

(3) A Brief Rule to Guide the Common-People of New-England how to Order Themselves and theirs in the Small Pocks, or Measels

By Thomas Thacher. Facsimile Reproductions of the three known editions, with an Introductory Note by Dr. Henry R. Viets. (Publications of the Institute of the History of Medicine, the Johns Hopkins University. Fourth Series: Bibliotheca Medica Americana, Vol. 1.) Pp. liv+16. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1937.) 7*s*. net.

(4) A Discourse upon the Institution of Medical Schools in America

By John Morgan. Reprinted from the first edition, Philadelphia, 1765. With an Introduction by Abraham Flexner. (Publications of the Institute of the History of Medicine, the Johns Hopkins University. Fourth Series: Bibliotheca Medica Americana, Vol. 2.) Pp. vi+vii+xxviii+63. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1937.) 9*s*. net.

(5) Adaptation in Pathological Processes

By Dr. William H. Welch. Reprinted from Transactions of the Congress of American Physicians and Surgeons, 1897, Vol. 4, pp. 284–310. With an Introduction by Dr. Simon Flexner. (Publications of the Institute of the History of Medicine, the Johns Hopkins University. Fourth Series: Bibliotheca Medica Americana, Vol. 3.) Pp. xi+58. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1937.) 7*s*. net.

(1) IN his work on early medieval medicine Prof. C. MacKinney, who occupies the chair of medieval medicine in the University of North Carolina, gives a richly documented account of medicine in that portion of the Middle Ages extending from the sixth to the eleventh century. During that period two distinct types of medicine were prevalent, namely, the supernatural, which included reliance on Christian saints and their relics, Christian-Pagan charms and magical incantations, and human medicine, which consisted chiefly of empirical methods of healing mainly by drugs, surgery and diet. Of the three lectures contained in the book the first deals with the changing modern conceptions of the Middle Ages formerly regarded as stagnant and unproductive but now looked upon as an era of vigorous activity.

In the second lecture, in which Prof. MacKinney discusses medicine in Merovingian and Carolingian France, it is shown that in the Merovingian age comprising the three centuries before Charlemagne there was a steady advance in France in medical practice which was accelerated during the tenth and eleventh centuries. Although the outstanding methods of medical practice at that time were as before blood-letting, diet and herbal potions, the clergy became more interested in medical conditions and took a much more active part in caring for the sick.

In the third chapter, which is devoted to medical progress at Chartres in the tenth and eleventh centuries, extracts from the works of Gerbert, Richer and Fulbert illustrate the separation of medical practice from mere book knowledge. Sixty pages of notes and photographs of medical manuscripts are appended to the text.

(2) Dr. Ramon Pardal's work which forms part of the series edited by Dr. Imbelloni, who contributes the preface, is divided into four parts devoted respectively to medical ethnology, medicine in ancient Peru and Mexico, stimulating, narcotic and hallucinating drugs, of which the chief are coca, maté and peyotl, and American drugs in modern medicine. In the first part the author shows that the medicine of the American Indian was of a primitive character, based on magic, therapeutical empiricism and the surgery of emergencies. The practitioner in those times was esteemed rather for his magical power than for medical knowledge. It was only among the peoples possessing a relatively superior feudal organization, such as the Incas and Aztecs, that the elements of a higher order appeared and the functions of priest and doctors were separated. The second part deals with the practice of medicine in old Peru, with special reference to the operation of

trephining and the representations of diseases, especially syphilis, on pottery. The drugs used in modern medicine for which we are indebted to the natives of South America include the balsams of Tolu and Peru, guiacum (once regarded as a specific for syphilis and now only employed in gout and chronic rheumatism), sarsaparilla (also used in former times as an anti-syphilitic drug, but now almost confined to quacks who sell it as a 'blood-purifier'), cinchona, copaiba, pilocarpine and chemopodium.

The work will appeal to the anthropologist and the ethnologist, as well as to medical practitioners and pharmacologists interested in the history of the healing art.

(3) Dr. Thomas Thacher's "Brief Rule", of which the three editions are published in this little volume, represents the earliest medical document to be printed in America north of Mexico. It consists of a single printed sheet which first appeared in 1677–78 and was reprinted in 1702 and 1721–22. The author was born in Somersetshire, but migrated with his parents to New England in 1635 at the age of fifteen years in accordance with the practice of many dissenting ministers and their families in the early part of the seventeenth century. Thacher was brought up to be a clergyman like his father, but like many of his contemporaries was something of a physician as well as a minister, and enjoyed a considerable practice at Boston. A severe epidemic of smallpox which broke out in that city in 1677 causing 700 deaths stimulated Thacher to publish his broadside, which is taken almost word for word from the second chapter of Sydenham's "Medical Observations". Subsequent outbreaks of smallpox in Boston in 1702 and 1721 were the occasion of the reprinting of the work.

(4) In the address which is here printed in facsimile and was delivered in 1765 in the College of Philadelphia, where he occupied the chair of the theory and practice of medicine, being indeed the first professor of medicine in the United States, Dr. John Morgan, who had received his medical education not only in Philadelphia but also in London, Edinburgh, Paris and Leyden, gives a general survey of the different departments of medicine and describes the existing conditions in America, the difficulties accompanying the study of medicine and the impracticability of making any great progress until it had been put on a better footing. The preliminary sciences of anatomy, materia medica, botany and chemistry are reviewed and their contribution to the cure of diseases considered. The necessity of a knowledge of Latin and Greek for the physician is then emphasized as well as familiarity with the French language, while acquaintance with mathematics and natural philosophy is regarded as indispensable. As regards the contemporary state of medicine in America in 1765, Dr. Morgan deplores the lack of professional teachers to give complete and regular courses of lectures in the different branches of medicine, in striking contrast with the medical schools in Europe which he had visited. He suggests, therefore, that a course of clinical practice and clinical lectures by physicians of knowledge and experience should be established to remedy this deficiency, and recommends the foundation of a medical library. He himself proposes to give a course of lectures on materia medica followed by one on the institutes and theory of medicine. Next he urges that the activities of physician, surgeon and apothecary should not be combined in one man, but asserts that "practitioners would enjoy much more satisfaction in practice if physic, surgery and pharmacy were in different hands". Finally, he dwells on the advantages which American students have over those in Europe in possessing an ample field for the study of natural history.

(5) Dr. William Welch's address, which represents the presidential oration delivered before the Congress of American Physicians and Surgeons in 1897, is, as Dr. Simon Flexner remarks in the introduction, as applicable to the subject to-day as it was forty years ago. Dr. Welch maintains that pathological adaptations have their foundation in physiological processes or mechanisms. Pathological adjustments, however, lack the co-ordinated fitness characteristic of physiological adaptation, as he illustrates by the case of a heart hypertrophied in consequence of a vascular lesion which does not completely restore the normal condition of the circulation. Similarly, a kidney hypertrophied in consequence of deficiency in the other kidney is more susceptible to disease than the normal organ. While adaptation is usually to some extent advantageous to the individual, it is not necessarily so, as is shown by a scar in the brain causing epilepsy. Throughout his address Dr. Welch emphasizes the importance of taking into consideration not only the facts of human and allied physiology but also those accumulating in the domain of experimental embryology and morphology, especially as regards the influence of various changes of environment, particularly of definite chemical, thermic or mechanical changes upon the movement or growth of cells.

In conclusion, Dr. Welch points out that systems of treatment based exclusively on the theory of the *vis medicatrix naturae* often rest on an insecure foundation, inasmuch as the agencies employed by Nature may be either inadequate or entirely helpless.

J. D. ROLLESTON.

A STUDY OF HUMAN RELATIONS

Man the Slave and Master

By Mark Graubard. Pp. x+366. (London: J. M. Dent and Sons, Ltd., 1939.) 10*s*. 6*d*. net.

TO-DAY, as never before, the man of science is faced with the problem of the relation of science and society. Science is a powerful weapon for evil as well as good, and it is the business of the man of science to ensure so far as he can that his work is not misused. One of the great difficulties of such a task is that few modern men of science are well informed outside their own fields of work. Still more is the layman ignorant of science, especially in that he is seldom acquainted with that manner of approach which is often termed the 'scientific method'.

Dr. Graubard has set himself the task of helping to remove this difficulty by presenting, in simple terms, an analysis of human behaviour and the composition of society based on biological knowledge. He discusses conditioning, heredity and evolution, both biological and social, and he does it in a way that should commend the book to men of science and laymen alike. He then turns to the application of his knowledge to the scientific control of human affairs, and though at this stage it is inevitable that some disagreement must arise, his analysis and proposals can be read with profit even by those whose views diverge most.

It is a pity that the book is marred in places by occasional inaccurate and loose statement. In the account of Mendel's work with peas, the round and wrinkled characters of the seed are described as determined by the mother plant's constitution, whereas they are, in fact, dependent on the genotype of the zygote itself. His implications that Mendelian inheritance in animals was first observed in rabbits and that departure from Mendel's second law, of independent assortment, was first found in Drosophila, show a lack of appreciation of Bateson's work with poultry and sweet peas. On p. 190, the author says "Hence they [that is, all the races of man] form a species" and on p. 195 "the Negro, who of all the species of man has the least hair". Other similar examples could be quoted.

These are, however, minor blemishes and should not be allowed to obscure the fact that Dr. Graubard has written a valuable book, at once critical and informatory. It should be read by all who are interested in the study of human relations.

K. MATHER.

CONSERVATION OF NATURAL RESOURCES

Conservation in the United States

By Prof. A. F. Gustafson, Prof. H. Ries, Prof. C. H. Guise and Prof. W. J. Hamilton, Jr. Pp. xi+445. (Ithaca, N.Y.: Comstock Publishing Company, Inc., 1939.) 3 dollars.

THE conservation and the restoration of its natural resources are perhaps the most important questions that the United States has to face. These are here divided into sections dealing with the soil, forests, wild life and minerals, especially coal and oil. Each is written by an expert who has researched with the view of ameliorating the present difficulties. Perhaps their most interesting feature is the close connexion, never stressed but everywhere made plain, between purely scientific investigation and the practical problems. This is as it should be, as the work is intended to be a text-book to stimulate students who have already had a broad scientific training. It everywhere sets out the historical facts, the present position and the possible and desirable remedies so far as the necessities induced by increase of population allow.

While mineral resources may be regarded as waning assets merely to be treated with the greatest economy, the soil and water are as necessary to man's existence to-day as in all ages. Passing over a section dealing with the topography of the country and the consequent production of soil regions of varied productivity, these always associated with water, there arise questions of soil depletion by the loss of plant nutrients and of erosion losses due to wind and rain. The white man found the eastern part of the country unbroken forest which had to be cleared for crops. Organic matter disappeared from the soil so that its surface was carried away by the rainfall, already half the top soil being lost by this means over an area estimated at 855 million acres. Another 322 million acres are

seriously depleted by wind erosion, so that nearly two-thirds of the country is affected. Remedies suggested are in the due employment of green manures, crops to be ploughed in to hold the water in the soil, and schemes of planting that will utilize the rainfall rather than encourage the formation of gullies, methods excellently shown in a series of photographs. These must be associated with considerations of the conservation and reafforestation of the woodlands, a problem of great complication since a large country is divided into many vegetative regions dependent on temperature, wind, rainfall and subsoil, each area with its own trees and undergrowth. Forest fires must be controlled, while waste in the lumber industry has to be avoided. Fortunately the questions here have become national, though the individual States and even counties are helping, appreciating the local effects on rainfall and the value of such wooded parks to the psychology of their own people. The national forests now aggregate 170 million acres, and the aim appears to be to double this amount by the planting of the high lands but mainly of the abandoned farming areas, and in this way reclaiming immense wastes.

The section dealing with the animal resources, fish, birds and game, is excellent. The decline of the supply of certain fish was inevitable in an absence of knowledge of their biology, but the Fish Commission has the matter well in hand and has already had striking success in matters of regulation, avoidance of pollution and hatcheries. The buffalo herds have gone for ever, but Pennsylvania has done fine work in the encouragement of deer, while the beavers, reintroduced from Canada less than twenty years ago, have now to be trapped—a new industry.

While in this study of the United States much is local, the analogy with Africa is striking, the terrain very similar. European countries start there with the experience of America through three centuries. This suggests the necessity for paternal governments to control unthinking settlers so that the land may not be impoverished. It may not ever require to be developed as that of the United States, but it will undoubtedly have to provide food for a teeming population. So far the agriculture of native areas is small, but the cow as the unit of wealth is disappearing and a certain change of habits in the native population must occur. The thoughts which are induced by this study of America should excite the imagination of all who have to rule in Africa, where clearly it is already time for regularized conservation.

J. STANLEY GARDINER.

FOUR-TERMINAL NETWORKS

Einführung in die Vierpoltheorie der elektrischen Nachrichtentechnik

Von Prof. Dr. R. Feldtkeller. (Physik und Technik der Gegenwart, Abteilung Fernmeldtechnik, herausgegeben von Prof. Dr. Heinrich Fassbender, Band 2.) Pp. ix+142. (Leipzig: S. Hirzel, 1937.) 8.80 gold marks.

THIS is an excellent introduction to the comparatively young theory of four-terminal networks, that is, of alternating-current transfer systems of which only the input and output pairs of terminals are accessible for measurements. After a brief outline of network analysis, the author passes in Chapter ii to a thorough theoretical investigation of linear symmetrical four-terminal networks, of which the behaviour for different terminal impedances is examined by means of circle diagrams based on the network parameters. The application in Chapter iii of this theory to the particular case of loss-free systems illuminates the theory through the relative simplicity of the circle diagrams required, while Chapter iv deals with asymmetric linear systems.

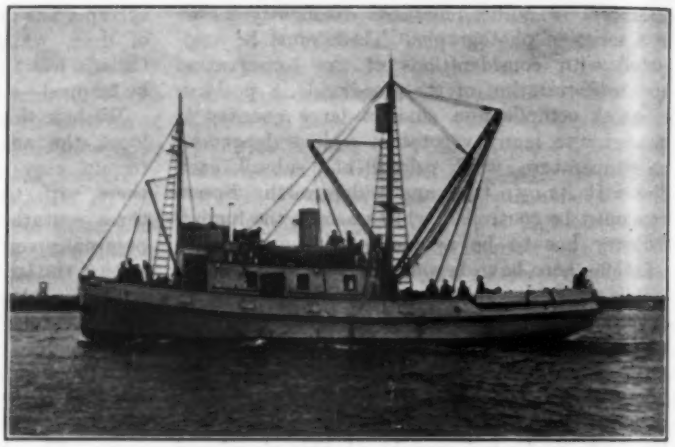
Chapter v treats the general theory of linear four-terminal networks by the use of matrix algebra, a field of electrotechnical advance in which the author was a pioneer. With this treatment, as the author remarks, the book passes from text-book to hand-book, and the two final chapters provide at once the tabular material for, and a demonstration of, the labour-saving use of four-terminal theory in matrix form. Matrices are derived for the fundamental interconnexions of the four-terminal networks, and the theory of propagation networks in cascade is touched on. In the sixth and last chapter are collected the matrices of simple four-terminal structures, including transformers and (linear) amplifying valves, while a final section shows the derivation of equivalent T- and π-networks for systems obeying the Kirchoff reciprocal principle, and for systems not so restricted.

The book is clear, neat and detailed; the few errors that have escaped the proof-reader are mainly of interest as evidence of revision by the author in the interests of clarity.

FISHERIES RESEARCH IN AUSTRALIA

BY SIR DAVID RIVETT, K.C.M.G.

SINCE the ill-fated trawler *Endeavour*, under Dr. Dannevig, was lost at sea in 1914, fisheries exploration has rather languished in Australia. This is scarcely pardonable in a country with 12,000 miles of coastline, a relatively poor fish supply, especially in the inland areas, and a definite need for quantities of fish meal on its stock farms. During the past two years, a vigorous effort has been made to improve matters under the Council for Scientific and Industrial Research working in co-operation with universities (particularly that of Sydney) and State Departments.



M.S. *Warreen*.

Dr. H. Thompson, formerly of the Newfoundland Fisheries Services, has been appointed officer-in-charge of investigations, and under his guidance the Station illustrated in the accompanying photograph is nearing completion. The site, made available by the New South Wales Government, is that of Dannevig's hatchery at Cronulla, the southernmost Sydney watering-place, on the Port Hacking estuarial group of salt-water inlets. It is admittedly a very beautiful spot for a marine biological station, with deep and shallow water frontages of rocky and sandy foreshores. Museum and library facilities are easily accessible in Sydney; and the fish market there will be useful in the collection of biological material and statistics from the trawling and seine-netting fleet.

MARINE BIOLOGICAL RESEARCH STATION, CRONULLA.

The aquarium and offices are in the left foreground and the main laboratory building in the right. Behind are the concrete tanks. On the shores are the pond and boat sheds.

The pre-existing hatchery appointments have been converted for experimental work. Salt water is pumped to a 25,000 gallon concrete tank and fed by gravity to an aquarium where the temperature is under control. A large tidal concrete pond (100 ft. × 42 ft.) has been reconditioned for the retention of fish for observation or experiment. New additions include a workshop, net- and fish-cleaning shed, and a main building containing offices, stores, biological, chemical and bacteriological laboratories, dark-room, charting and drawing room, and a large library. Refrigerating cabinets and a small canning plant are provided.

A 16-ft. motor skiff has been built for local sampling work and a 2-ton truck has been equipped as a mobile laboratory.

For exploratory work, mainly on pelagic, or

surface-swimming, fish, M.S. *Warreen* (a native name for the sea) was built in Melbourne and has been in commission for about fifteen months. She is 82 ft. long, of 108 tons displacement, and is fitted with a 215 h.p. main engine of Atlas Polar Diesel construction, with Ruston auxiliaries. She carries radio equipment for transmitting and receiving, and an echometer for automatic recording of depth. A small laboratory permits limited work at sea. A large purse-seine net is carried on a turn-table in the stern.

Over so great an extent of sea, one small vessel capable of a speed of only 9 knots can do but little: hence very full use is being made of reconnaissance from the air. Aircraft and personnel are made available to the Council by the Royal Australian Air Force; and particularly in the 'spotting' of shoals of tuna and so-called salmon (*Arripis trutta*), air observation has been conspicuously successful. Already possibilities have been demonstrated which are attracting the attention of commercial men; but a great amount of scientific investigation will be necessary before a sound basis for fisheries development is secured.

STRUCTURE OF THE RAYON FIBRE

By Prof. H. Mark

REFERENCE has frequently been made in these columns[1] to the progress of our knowledge concerning the structure of natural and artificial fibres during the last few years. The accompanying illustration (p. 314) gives a résumé of the present state of knowledge as represented by the cellulose fibre, which is very well known and at the same time of great economic importance.

The illustration was made up under the assumption that we have at our disposal a microscope allowing us magnifications of unlimited amounts in such a way that we can always increase its resolving power by the factor of 10 by switching in another imaginary objective. Looking at a rayon thread through such a microscope, we should obtain such a series of pictures, and it seems desirable to discuss them one after the other and to point out what kind of information they give and to what extent the particular qualities of the fibre are shown by them.

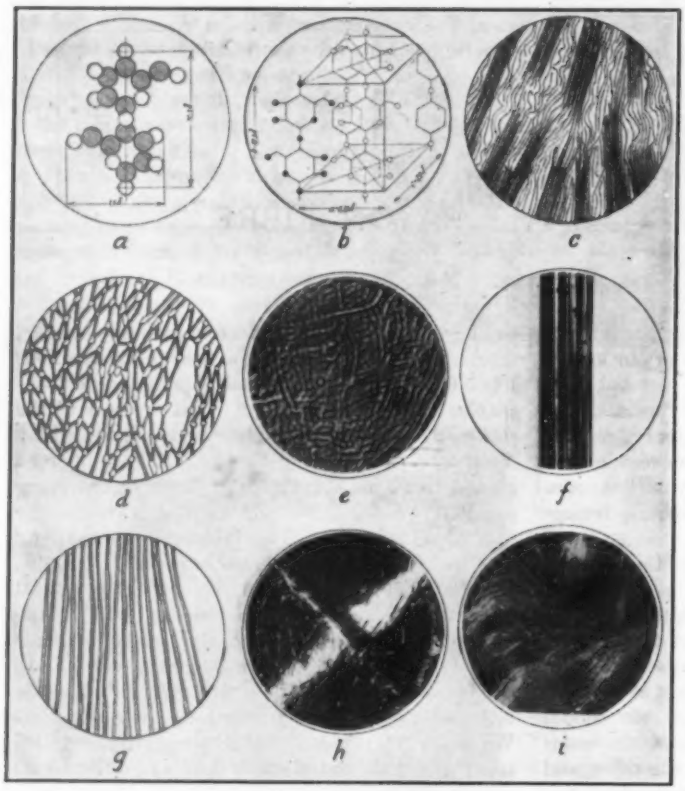
(*a*) We start with the highest magnification, about 1 to 50,000,000, and observe the *fundamental chemical unit* of cellulose, namely, the *glucose residue* composed of 6 carbon atoms, 10 hydrogen atoms and 5 oxygen atoms[2]. These glucose units have a ring structure and are linked together by main valence bonds. They stand for the chemical behaviour of the material, for example, for the fact that cellulose is easily wetted and swells in water, but does not take up organic substances such as petrol, benzene or oil. They are also responsible for the fact that one can produce certain derivatives of cellulose, namely, cellulose nitrate (celluloid), cellulose acetate (cellon), etc. Finally their presence is responsible for the fact that by hydrolysis cellulose can be converted into a sugar.

(*b*) We pass now to the next magnification, 1 to 5,000,000, and get an insight into the *crystallographic unit* of the fibre. What we see is the *elementary cell* of the cellulose lattice revealed by X-ray investigations[3]. We see that the different glucose residues are united to long chains lying parallel to each other and running through the fibre along its axis. The presence of these long and highly orientated chains explains the double refraction of the material, its high mechanical tenacity, the anisotropy in swelling and the behaviour towards substantive dye-stuffs.

(*c*) When we switch in a magnification of 1 to 500,000 we get the next picture. Here each single chain of diagram *b* is represented by a thin line. We learn that these chains are partly bundled together with a considerable degree of order forming a *micellar structure*, and partly they represent a complicated framework of entangled fringes[4]. We get the impression that the whole fibre consists of parts with comparatively high crystallographic orientation and of other parts which can be called amorphous. This peculiar structure accounts for the fact that rayon fibres at the same time show a considerable strength and a high elasticity. It is responsible for the amount of swelling, the dyeability, and the resistance to creasing. Every process that aims at producing rayon has to take account of this fact.

(*d*) The next step, leading to a magnification of 1 to 50,000, gives a more general view of this *fringe and net structure* of cellulose. In *d* the parallel strokes represent the crystallized areas while the small irregular circles are the amorphous regions. We see that the fibre may be regarded as an

irregular flexible net built up of these two units and exhibiting at certain places larger holes which, of course, are in some way due to the origin of the material[3]. This structure is in general connected with the mechanical properties of the thread with its elasticity, plasticity, tenacity and its chemical reactiveness. The spaces and crevices between the crystallized areas absorb dye-stuffs, wetting agents and other reacting substances. They are of great importance to the behaviour of the fibre as a textile.



(*e*) We have reached a magnification of 1 to 5,000 and are now at the utmost limit of normal microscopic resolving power. The differentiation of picture *d* has disappeared and we observe a *fibrillar structure* in which the morphological units of the fibre are visible. They may be not so pronounced in artificial filaments and hence the above picture shows the fibrillar structure of a cotton fibre. The length, width and orientation of the fibrillæ are of great importance for all the finer textile properties such as elasticity, softness, lustre, creasability, etc.

(*f*) Switching in the next magnification, 1 to 500, we have finally reached the range of microscopical observation with normal light[4]. The picture shows a *viscose rayon thread* exhibiting a system of stripes parallel to its fibre axis. They are responsible for the soft lustre of the yarn, its pleasant appearance, and its easy dyeability. Pictures such as this are of great importance in technical routine tests carried out in rayon factories. The present one, for example, shows little specks indicating that some contamination of the material has taken place.

(*g*) This picture, with a magnification of 1 to 50, shows a bundle of a normal *viscose rayon thread*. Pictures of such kind are of importance to control the levelness of the yarn, its homogeneity in diameter, colour, dyeability and lustre.

(*h*) and (*i*) The last two pictures finally give us the well-known aspect of an artificial *silk yarn* with a magnification of 1 to 5 and without magnification at all. They need no explanation, being familiar to everyone.

The set of the above nine pictures may offer a certain insight into the structure of a very important substance starting from the trade product, namely, *rayon yarn*, and ending with the last detectable chemical unit, namely, the *glucose residue*. The location and understanding of every single structural principle is of importance, for each influences all the different technical qualities of the final product; the better and more accurate these nine pictures can be made, the higher will be the probability to make a rayon yarn of best quality.

[3] See, Astbury, W. T., NATURE, **141**, 968 (1938). Clark, L. H., NATURE, **142**, 899 (1938). Bragg, W. H., NATURE, **142**, 910 (1938).

[3] Compare, Haworth, W. N., "The Constitution of Sugars" (London, 1929). In (*a*) the positions of the hydrogen atoms are omitted because they could not be located experimentally; shaded circles represent C-atoms, the open ones O-atoms. Dimensions of residue, 10·3 A. and 7·5 A.

[4] See, Polanyi, M., *Naturwiss*, **15**, 288 (1921). Sponsler, L. O., and Dore, H. W., *Coll. Symp. Mon.*, 174 (1926). Meyer, K. H., and Mark, H., *Ber.*, **61**, 593 (1928). Astbury, W. T., "Fundamentals of Fibre Structure" (Oxford, 1933), p. 77 *ff*. Gross, S. T., and Clark, G. L., *Krist.*, **A**, **99**, 357 (1938). Meyer, K. H., Misch, L., and Badenhuizen, N. P., *Helv. Chim. Acta*, **22**, 59 (1939). Crystallographic dimensions, $a = 8{\cdot}35$ A.; $b = 10{\cdot}3$ A., $c = 7{\cdot}9$ A.

[4] Astbury, W. T., *Trans. Farad. Soc.*, **28**, 232 (1932). Mark, H., *Rayon Record*, 498 (1932); *Trans. Farad. Soc.*, **29**, 6 (1933). Houwink, R., *Trans. Farad. Soc.*, **31**, 10, 28 (1935). Frey-Wyssling, A., *Prot.*, **26**, 262 (1936).

[5] Gerngross, O., Hermann, K., and Abitt, W., *Biochem. J.*, **223**, 499 (1930). Hermans, P. H., *Koll. J.*, **81**, 143, 300 (1937); **82**, 58; **83**, 71 (1938); **86**, 107 (1939). Kratky, O., *Koll. J.*, **80**, 139 (1937); **84**, 268 (1938). Kratky, O., and Mark, H., *J. Phys. Chem.*, B, **36**, 129 (1937).

[6] Farr, W. K., Eckerson, I., and Sisson, W. A., *Contrib. Boyce Thompson Inst.*, **6**, 189, 309, 315 (1934). Bailey, A. J., *Ind. Eng. Chem.*, **30**, 40 (1938).

POLYPLOIDY INDUCED BY COLCHICINE AND ITS ECONOMIC POSSIBILITIES

By Dr. G. H. Bates,
The Farm Institute, Penkridge, Stafford

THE technique employed by plant breeders has undergone revolutionary changes since the first workers began the production of new and improved varieties. The methods of the selectionists, such as Luther Burbank, were certainly spectacular, but they were laborious, expensive and haphazard. Mendelism marked a great step forward, in that it was possible to work along preconceived lines in an orderly and economical manner with a fair idea of what was likely to materialize. There is no doubt, however, that Mendelian methods have taken us as far as they can, at least in respect of our commonest crop plants. We have exhausted all possible combinations of known characters and have reached a point where, as Salaman has declared, we are simply 'ringing the changes' on existing material. A point has been reached where the hybridizer can only wait for some new mutation to turn up.

Attempts have already been made to produce these mutations by the artificial production of polyploidy. Such practices as thermal treatment, centrifuging and decapitation of the apical shoots in the seedling have proved successful in a very small number of cases. They are, however, far too laborious to be considered worth while.

In view of the above facts, it is small wonder that the discovery by Blakeslee and Avery of the value of colchicine as an agent for the production of polyploidy has received a great welcome. The need for such a stimulus has probably accounted for the wave of optimism which seems to have swept through the ranks of plant breeders throughout the world. Results up to the moment, however, scarcely seem to justify the description of the new technique as being more than promising.

The drug colchicine, prepared from parts of *Colchicum autumnale*, has been known to physicians for many years, mainly as a specific for gout. Hope was expressed that it might also prove to have an inhibiting action on carcinomatous cells. It is only recently that its influence on mitosis has been discovered and put to practical application.

There have been several theories as to the exact manner by which it brings about somatic doubling. It has been suggested that nuclear division takes place at a greater rate than cell division, under the influence of colchicine, thus resulting in bi-nucleate cells with subsequent fusion of the pairs of nuclei. The investigations of Levan, supported to a certain extent by others, have practically established the fact that another mechanism is responsible. It appears that inactivation of the nuclear spindle prevents anaphase reduction, thus leading to a doubling of the chromosome number. Experiment has shown that meiosis is also affected, but this has no economic application as has the influence on mitosis.

The exact action of colchicine and the mechanism by which changes are effected has great interest for the cytologist. However real may be the achievement in this direction, the practical plant breeder is more concerned with the accomplished fact and its possibilities.

Literature on the subject has already assumed large dimensions and results pour in from all parts of the globe. The number of workers is now so great as to make a detailed account of their different activities impossible in a small space. A review of available publications leaves one with the impression that, in the main, reports are fragmentary and often unconvincing.

Easy and rapid methods for identifying the polyploid condition are certainly desirable; but it is doubtful whether they are, as yet, sufficiently trustworthy to be used in proof of claims made for the results of a new and revolutionary technique. One could wish that statements were supported by something more concrete than such criteria as pollen grain size, dimensions of the stoma guard cells and *gigas* characters. On the other hand, claims for the production of tetraploid plants of several species are made which are supported by chromosome counts. It must be conceded that the work is as yet in its infancy, and technique is by no means perfected.

The practical application of the treatment has taken different lines and there are several methods for the administration of the alkaloid. The soaking of the seed in dilute solutions varying in concentration from 0·05 to 1·0 per cent is the commonest practice. The influence upon the seedling depends upon such factors as the concentration of the solution, period of soaking, nature of the testa and the rapidity with which the seed germinates. In some cases it is suggested that the testa should be removed or that the seedling itself should be treated.

A large amount of routine work is necessary to determine the optimum concentrations for the seeds of different species. I have found that a 0·05 per cent solution has a profound influence on the seedlings of mustard after soaking the seed for four days. In the case of several gramineous species the seed of which had been treated in like manner, only a very small proportion of individuals was visibly affected. In the case of sweat peas, the seeds either failed to germinate or the distorted seedlings perished.

The main objection to seed treatment is that germination is either partially or completely checked, root development is restricted or absent for some considerable time and a great waste of material occurs. There is a characteristic swelling of the hypocotyl, more notable in some species than in others. Many odd distortions occur, each characteristic of a particular species.

The treatment of apical and axillary buds has produced tetraploid shoots. This is affected by painting on the solution, in combination with a wetting agent, by spraying or by immersion. A 0·4 per cent solution is recommended by American workers for the direct application method.

Spraying of the parts is the least desirable of methods from the operator's point of view. It is important to stress the fact that colchicine is a dangerous drug and that in the hands of irresponsible persons disastrous results may occur. The human mucous membranes are particularly sensitive and one reads of serious eye injuries.

I have employed the 'injection' method as elaborated, for other purposes, by the East Malling workers. A 0·05 per cent solution has been used, a vertical slit in the stem of the plant or a severed petiole being placed in a tube of the solution. Profound morphological changes take place, and, as the influence is localized, its intensity varies throughout the affected part of the plant. In the case of *Vicia Faba*, the flowers were swollen at the base and were all abortive except two. These gave rise to pods showing *gigas* characters with an erect habit of growth. In *Fragaria* species, distorted fruits have been produced. A large amount of material has been treated by this method, but it is as yet too early to determine whether polyploidy has resulted.

Colchicine is an expensive commodity and investigations are proceeding to explore the possibilities of acenaphthene as a cheaper substitute. Kostoff has shown that the disintegrating fragments of the corm of Colchicum can produce polyploidy in germinating seedlings in close proximity.

Reviewing the whole of the work on induced polyploidy in a dispassionate manner, one must admit the remarkable nature of the achievements from the cytological point of view. Whether there will be much material gain accruing to the plant breeder remains to be seen.

In the case of garden plants there are distinct possibilities. Abnormal or distorted varieties with unusually large flowers have an economic value with a public displaying an insatiable appetite for novelty. Food plants are in a different category. Tetraploids are of frequent occurrence, but are not always of special merit; in fact, the reverse quite often obtains. Increased size is not always of importance, for with most of our arable crops there are varieties capable of producing plants just as large as the soil will grow them.

We do not, of course, know how the new tetraploid types will react to disease infection, how their cooking qualities may be affected for better or worse, or how altered morphological characters may be of benefit to the cultivator. For the present the chief possibility appears to be the production of fresh material upon which to build.

OBITUARIES

Dr. A. Harker, F.R.S.

THE death of Dr. Alfred Harker, emeritus reader of petrology in the University of Cambridge, on July 28 at the age of eighty years has removed from our midst an outstanding figure in British geology—one whose brilliant contributions in his own field over half a century placed him in the forefront of living petrologists.

Born in Hull on February 19, 1859, Harker entered St. John's College, Cambridge, in 1878 and graduated eighth wrangler in the Mathematical Tripos of 1882. He was placed in the first class of both parts of the Natural Sciences Tripos with physics as his chief subject, and was elected to a fellowship in his college in 1885. Though not of the 'Bonney School', so much were his early geological interests strengthened at St. John's that he was eventually attracted to a demonstratorship under McKenny Hughes. He became University lecturer in 1904 and on the death of Hughes in 1917 was elected to a special readership in petrology.

Harker's earliest papers dealt with the cleavage structure of slates, an investigation for which his mathematical training peculiarly fitted him. These studies were based in part on his observations on the

slates of North Wales, where soon he became absorbed in a new interest—"the petrology of the igneous rocks associated with the Cambrian (*Sedgwick*) system of Carnarvonshire"—and endeavoured to trace the relationship of the igneous phenomena of the district and concurrently operating crustal stresses, a theme which he was greatly to amplify in his later writings. The results of this work were incorporated in the Sedgwick Prize Essay for 1888. During 1889–93 he was engaged in the Lake District where, in collaboration with J. E. Marr, he traced a varied group of lavas, ashes and sediments into the aureole of the Shap Fell granite. These papers form pioneer contributions on the nature and origin of metamorphic rocks and rank with Rosenbusch's classical studies on the *Steigerschiefer* of the Vosges.

With a reputation now thoroughly established, Harker, at the instance of Sir Archibald Geikie, was seconded in 1895 to the Geological Survey of Scotland for summer field work in Skye. The mapping of the mountainous groups of the Cuillins and the Red Hills of central Skye which followed, was completed in 1901, and will ever remain as a monument to his skill and ardour as a field geologist, and disposed finally of the embittered controversies of Judd and Geikie on the igneous succession of that island.

The outcome of his researches in Skye, and later in Rum, appeared in two Survey memoirs—"The Tertiary Igneous Rocks of Skye" (1904) and "The Geology of the Small Isles of Inverness-shire" (1908)—and at once attracted wide attention. Considering the time of their execution, and as the work of one individual, these researches will always rank as one of the greatest achievements in igneous geology.

The way was now prepared for Harker to present to a wider audience his long-considered views on the broad aspects of magmatic descent and the controlling influence of tectonic environment. These problems, among others, he unfolded in his "Natural History of Igneous Rocks" (1909). Written in an extremely lucid style and with a rare power of philosophical generalization, this volume has come to exert a deep influence on petrologic thought. If some of his conclusions have needed amendment, in its broad lines, his achievement has been none the less fundamental.

The same philosophic outlook characterized Harker's presidential addresses to the Geological Society. In the last of these he returned once more to the subject of metamorphism, a field which became his dominant interest in later years. His final work appeared in 1932 under the title "Metamorphism", a treatise which has been appraised in the words of an acknowledged authority as filling "an important place in the literature of petrology, and in lucidity, balance and breadth of view can serve as a model to all future writers on the anatomy and history of rocks".

Harker was elected a fellow of the Royal Society in 1902 and awarded a Royal Medal in 1935. From the Geological Society of London he received in succession the Murchison and Wollaston Medals. Honorary doctorates were conferred upon him by the University of Edinburgh and McGill University, while he was honorary or corresponding member of many scientific societies, British and foreign. These honours he accepted with such extraordinary modesty that many of them remained hidden and unsuspected by even those most intimate with him.

Harker's elementary lectures made little appeal to the average Tripos man, but he excelled in contact with senior students, and his advanced courses became the source of inspiration to many generations of students.

After his retirement in 1931, and to within a few weeks of his death, he continued to devote much time to the care of the petrological collections of the University. In the Harker Collection of rock slices numbering now some 40,000 slides neatly labelled in his own handwriting and representative of research material drawn from all quarters of the globe, he has endowed his department with a unique monument.

At St. John's College, where he had been for some years the senior fellow in residence, he was rather a lone figure, though on his retirement he seemed to cast off some of his natural reserve. By his old pupils he was held in affectionate regard, and the expression of this esteem was signally evoked at the dinner held in his honour at Cambridge on the occasion of his eightieth birthday. Those who were privileged to have his confidence and companionship will retain a lasting memory of the generosity and humility of a truly great man.

C. E. T.

Mr. W. Scoresby Routledge

We regret to record the death of Mr. W. Scoresby Routledge, traveller and anthropologist, which took place suddenly at Paddington on July 31 in his eightieth year.

William Scoresby Routledge was born at Melbourne in 1859 and was educated privately and at Christ Church, Oxford, graduating in 1882. He then entered University College Hospital, London, where he was Erichsen prizeman in operative surgery. He was, however, at heart an explorer, and for many years lived among primitive peoples. With the Micmacs of central Newfoundland, primitive tribes at that time still living mainly by hunting and fishing, he became proficient in woodcraft and learned to endure conditions which to the ordinary civilized individual would appear to border on privation. This early training served him to good purpose in his later travels, more especially during his stay among the Akikuyu of East Africa Colony, now Kenya, with whom he lived at a time when there was little exaggeration in terming them a 'prehistoric' people—the title he gave them in the valuable study of their manners and customs in "With a Prehistoric People" (1910), of which he was the joint author with his wife, Katherine, the daughter of the late Gurney Pease of Darlington, whom he married in 1906.

Mrs. Routledge, who had read history at Oxford, guided by the influence of Dr. R. R. Marett, was no less a keen anthropologist than her husband, and even while their joint book on the Kikuyu was in the making they were already planning their next and most important expedition. This was a journey

to Easter Island to investigate and explore systematically the antiquities of that island, and more especially the origin and meaning of the sculptured statues and the script for which the island is famous, and of which the meaning had long been sought by travellers and anthropologists. The expedition, which sailed in a small schooner-rigged yacht with auxiliary power, named the *Mana*, which Routledge had built for the purpose, was in Easter Island when the War broke out in 1914. It returned to England in 1916, after visiting a number of islands in the Pacific, including Pitcairn, from which they brought back two descendants of Young, the mutineer officer of the Bounty, whom they presented to His Majesty King George V in an interview in July 1916. Further research on the history of Easter Island was carried out in 1920 and 1922, when the Routledges visited and surveyed the Austral and Gambier groups and collected much valuable anthropological material bearing on distribution. The results of the earlier expedition were published in a volume "The Mystery of Easter Island" which appeared in 1919.

WE regret to announce the following deaths:

Sir Edward Brown, former secretary of the National Poultry Council and first president of the World's Poultry Science Association, on August 7, aged eighty-seven years.

Miss A. R. Clark, librarian at the Laboratory of the Marine Biological Association of the United Kingdom at Plymouth.

Dr. Edmund Heller, director of the Fleishhacker Zoological Park, formerly director of the Milwaukee Zoological Gardens, on July 18, aged sixty-four years.

Prof. L. Lévy-Bruhl, professor of philosophy in the Sorbonne during 1899–1927, president of the Institut française d'Anthropologie during 1927–30, aged eighty-two years.

Dr. Heinrich Poll, formerly director of the Anatomical Institute, Hamburg, on June 12.

Prof. W. A. Tarr, professor of mineralogy and geology in the University of Missouri, on July 28, aged fifty-eight years.

NEWS AND VIEWS

Memorial to Sir William Perkin

IT was a pleasing thought of the people of Sudbury, now part of the new borough of Wembley, and of the friends of the late Sir William H. Perkin, to commemorate his long residence there by the erection of a memorial in the form of a tiny garden of rest and a large oval oak seat. The memorial was unveiled by the eldest Miss Perkin on August 12 in the presence of the civic authorities, the church, some friends and a large number of the public. An appropriate oration on Perkin's life and work was given by Dr. C. E. Goddard. The growth of London has swept away the peaceful home and garden and fields where Perkin retired to in 1874 to devote his life to research; he became also a good citizen and much beloved in the village. The memorial stands on a corner of his land, the noisy traffic thunders past it on two sides and there is a round-about in front. But this tiny spot is a haven of refuge and peace, and those who use it for a few moments in years to come can read the tablet and muse perhaps on what kind of a man was this Perkin, founder of the dye industry. 'Scientist and citizen' might appropriately have been added, for it was as the latter, a man conspicuous for his probity and good works, that Sudbury knew him.

Ship-Burial and Treasure Trove in Suffolk

THE verdict of the jury at the coroner's inquest, which took place on Aug. 14, on the Anglo-Saxon ship-burial, or rather on the grave furniture in precious metals found therein, at Sutton Hoo in Suffolk (see NATURE of August 5, p. 239), was such as, perhaps, might well have been expected. It would be more than difficult to argue convincingly that a royal burial, in the circumstances indicated here by the character of the relics, could have taken place with that secrecy and intention to resume possession, which have been laid down from time to time in legal pronouncement as the essential principle of 'treasure trove'. Unless the matter is carried further in the High Court, as Mr. L. H. Vulliamy, the coroner, indicated as a possibility, the Sutton Hoo treasure now becomes legally the property of Mrs. E. M. Pretty, the owner of the land upon which the burial was found by Mr. Guy Maynard of the Ipswich Museum. It may be hoped, however, that arrangements will be made in due course to ensure its display to the public and availability for study, as its historic interest demands. It would now appear, since there has been an opportunity for the articles to be examined and cleaned in the British Museum, that the find is far more valuable than was at first reported. This is shown in the evidence of Mr. C. W. Phillips of Selwyn College, Cambridge, who had been in charge of the opening of the tumulus since July, and also in a supplementary note contributed by *The Times* museum correspondent in the issue of August 15 which mentions more especially the silver. The objects in this metal include six shapely shallow bowls in almost perfect preservation, about 8 or 9 inches across, and all provincial Byzantine or late Roman. They are decorated with a broad cross, usually of a quatrefoil pattern. A silver dish decorated with a classical woman's head is provincial Byzantine work of the sixth century. A large platter, 28 inches across, was made at Constantinople, and bears marks of the reign of Anastasius I. The gold work, however,

is Saxon, and is said to be extremely massive. In association were forty Merovingian coins. It is thought that this may be the burial place of Redwald, the first of the East Anglian royal family to become High King of England.

The British Speleological Association

DR. R. R. MARETT'S presidential address to the fourth annual Conference of the British Speleological Association, which met at Swansea on August 5–8, tendered in humorous vein an anthropologist's explanation of the attraction of the modern study of caves in 'speleolatry'—primeval man's worship of the cave, which in the racial consciousness of a late-born generation had assumed the guise of a devotion to science. He was, however, able to support his contention that speleolatry stood for something real in the history of religion by reference to the evident mystic intention, at least in part, of the palæolithic cave art of France and Spain and the therapeutic cult of the cave of later times. No doubt Dr. Marett had in mind the symbolism of a mystic ritual of approach, when at the opening of the Conference he presented Sir Cyril Fox, director of the National Museum of Wales, with a silver key. Members of the Association were given ample opportunity to experience the inward thrill of which their president had spoken, in the visits which were paid to the numerous caves on shore and inland in the neighbourhood of Swansea, in which the Paviland cave in the Gower Peninsula, famous in the annals of palæontology for its association with the name of Dean Buckland, received its due meed of attention; while in the exhibition arranged by Mrs. A. Williams at the Royal Institution of South Wales, they found illustration of the cave sites and their structure, as well as of the evidence of their occupation by men and animals, ranging from Mousterian to medieval times. Among those who addressed the Conference were Prof. T. Neville George, who discussed the geological aspect of the caves of South Wales, and Prof. Bosch-Gimpera, formerly rector of the University of Barcelona, who dealt with the cultures of the Spanish caves. Dr. Marett was re-elected president of the Association, with Prof. L. S. Palmer as chairman.

Totemic Ceremonial in Arnhem Land, Australia

DR. DONALD F. THOMSON, who was specially commissioned by the Government of the Commonwealth of Australia to investigate conditions among the aborigines of the Northern Territory during 1936–7, has collected much information relating to the customs and beliefs of the tribes of Arnhem Land, shown in numerous papers published in scientific periodicals and elsewhere since his return to England. He has obtained evidence, for example, running counter to the opinion, long generally accepted, that the indigenous peoples of Australia had been virtually free from external influence after their settlement there. It is now accepted, however, that influence from the north entered the continent at York Peninsula by way of Torres Strait; and Dr. Thomson finds in the use of wool or fabric to represent the hair of a dog in totemic ceremonial evidence of intercourse with early Malayan or Macassar voyagers, by whom this greatly valued material was brought to the area. Although the dog, which forms the central figure in a remarkable totemic ceremonial witnessed by Dr. Thomson and described by him (*Illustrated London News*, August 12), has been assimilated by the natives to the Australian dingo, it bears unmistakable evidence of an external origin, while the rites differ in many ways from the typical Australian totemic ceremonies. The ritual performance re-enacts in pantomime the myth of the original pair of 'dog' ancestors, who sank in the mud and were overwhelmed by the sea in trying to reach a stranded whale. Finally, they were turned into a great rock, whence now come the baby spirits of members of the clan who enter the mother at pregnancy. In the totemic ceremony, the figure of a dog, which has been constructed by the old men in secret, after giving birth to puppies—an event symbolized by cutting off the hindquarters—is carried along a road while members of the tribe imitate both the gait of puppies and the struggles of the original pair when caught in the mud. One of the tribal totems is a representation of a 'square-face' gin bottle carved in wood.

International Congress of Americanists in Mexico City

THE twenty-seventh International Congress of Americanists was held in Mexico City during August 5–15. General Cardenas was honorary president of the Congress, the acting president being Dr. Alfonso Caso, director of the National Institute of Archæology and History, whose excavations on Monte Alban have so greatly enriched the national collections of pre-Hispanic antiquities. Mr. T. A. Joyce, formerly of the Ethnographic Department of the British Museum, and Dr. Paul Rivet, of the Musée de l'Homme, Paris, and the foremost authority in France on the ancient indigenous peoples of America, were among those elected as vice-presidents for the meeting. According to a dispatch from the correspondent of *The Times* in the issue of August 8, 120 European and 180 Mexican and other American archæologists, anthropologists, and historians attended at the Congress. Communications were submitted in nine sections, which included anthropogeography, physical anthropology, American prehistory and archæology, as well as a section devoted specially to the prehistory and archæology of Mexico, linguistics, social anthropology and a section dealing with the practical problems which affect the indigenous and negro population of the continent. Excursions were made to archæological sites at Acolman, Teotihucan, Tenayuca, Tepotztlan, and the now famous Monte Alban.

Joint Industrial Councils

A BROADSHEET issued by Political and Economic Planning (P E P) reviews the present position of the joint industrial councils and their development from the Whitley Committee in 1916. During 1918–21, National Whitley Councils were established in 80

industries but afterwards a number of joint industrial councils collapsed or became moribund. By 1924 there were more than 30 trade boards and more than 50 Whitley Councils in existence but only three new national councils were set up between 1921 and 1930. Although the General Strike of 1926 emphasized the need for a more constructive relation between management and labour, and the Mond-Turner conferences assisted to break down old suspicions and frictions, the position between 1928 and 1934 was stationary. In the last few years, the basic ideas of industrial democracy, industrial organization and standing committees have gained support, and machinery for their implementation has been consolidated. Since 1933, new trade boards have been established in four industries, as well as a form of district organization, with statutory application of agreements, in road transport, while negotiations are proceeding for the improvement of conditions in retail trades by co-operative methods.

THE broadsheet describes in some detail the establishment, achievements and limitations of the two new Whitley Councils, the National Joint Industrial Council for the Clay Industries and the corresponding Council for the Cast Stone and Cast Concrete Products Industry. In addition the tendency in the older industries for standing committees representing employers and operatives and others, such as the Joint Committee of Cotton Trade Organisations, to be set up for many purposes is increasing. The building trades have set up the Civil Defence Constructional Industries Committee for the organization of demolition and rescue squads (both light and heavy) in the localities. A Joint Consultative Committee, representing the building employers, operatives and defence departments has also been set up to discuss defence problems affecting the industry. In flour milling there has been a joint deputation to the Government with proposals for maintaining supplies in war-time, while in the docks the employers and operatives are working out a scheme for the transfer of labour from port to port under emergency conditions in war-time. The driving force for co-operative effort no longer comes from a minority of enlightened employers and trade union leaders: on the workers' side particularly the impetus comes from the rank and file as well as from headquarters. Persistence of this attitude should lead to a new period of expansion in the organization of co-operation in British industry.

The Rockefeller Foundation

FIFTEEN million dollars were disbursed in 1938 by the Rockefeller Foundation for the advancement of "the well-being of mankind throughout the world". Being more than twice the year's income, this huge expenditure involved recourse to the principal fund as well as reducing accumulated balances. In addition to its complete annual report, the Foundation has published for wider circulation in pamphlet form an extraordinarily interesting review by its president, Raymond B. Fosdick. In the field of public health, in which alone the Foundation itself undertakes the conduct of operations, the fight against yellow fever progressed satisfactorily and more than a million vaccinations were performed with its new virus (17*D*). But a more formidable task is resistance to the invasion of South America by *Anopheles gambiæ*, the most deadly of Africa's malaria carriers, introduced apparently by air traffic into Natal in Brazil nine years ago and steadily spreading westward. The Foundation is now co-operating with the Government of Brazil in organizing an anti-gambiæ service. In all, 2½ million dollars were given to public health work. The account of contributions to work in the medical sciences is prefaced by a note on the comparative volumes, trends and merits of private and public support of medical research in America and Europe and on the particular fields in which further research is likely to be most productive. One of the least developed is that of mental hygiene: "In no other field is the need more desperate or the potentialities for useful advances more promising. . . . Cases of mental and nervous diseases occupy more hospital beds in this country than all other diseases combined."

WHILE medical sciences absorbed a quarter of the Foundation's 1938 appropriations (not counting 1,580,000 dollars given to the China Medical Board under an earlier authorization), an equal amount was spent in support of the social sciences, chiefly by financing a five-year programme of research and training in public administration in non-academic institutions. Believing that an understanding of the social forces moulding the future can only be arrived at through the dispassionate scientific approach which gave us command over our physical environment, the Foundation continued its support of various organizations working along such lines, notably the Institute of Pacific Relations and the Geneva Graduate Institute of International Studies. Of the 3 million dollars given to the natural sciences, more than half went to the University of Chicago for the endowment of biological research and more than a million in grants to other institutions for work in experimental biology. For projects of rural reconstruction in China 300,000 dollars were given, and despite Japanese depredations all these projects are still functioning. A sketch map shows the enforced transference towards the south-west of the scene of their operations.

Conditions and Aspects of the Scientific Profession

THE summer number of the *Scientific Worker* includes an account of an investigation of the profession of science which the Association of Scientific Workers is undertaking. The inquiry covers the methods of entry into the scientific profession and the actual conditions and economic aspects of the profession. The plan of research is designed to include a study of undergraduates in science departments and a study of practising qualified scientific workers. The former will endeavour to discover the factors which determine the decision to take a university course, the choice of university and course of studies and the extent to which vocational wishes influence

these problems. The second will cover three groups of men of science—chemists, physicists and biologists—and will be directed to discover the objective conditions of scientific employment and the attitude of men of science to scientific training and employment. These studies will cover the training for and obtaining of scientific posts, the conditions of scientific employment as well as the tenure of posts and incidence of unemployment. The studies on attitude will embrace attitude to university, to employment and to the main types of professional associations. It is hoped that the results obtained will provide data upon which policy for the regulation of the scientific profession can be based and also indicate how the practice of science in industrial firms affects the development of industry as well as possibilities in the application of science to industry.

Education in Germany

THE main features of education in Germany as remoulded under the Nazi regime are presented in a bulletin ("Education in Germany". Washington, D.C.: Government Printing Office, 1939) prepared for the United States Office of Education by Dr. Alina Lindegren, specialist in west European education, who visited Germany in 1935 and 1936 and completed her investigation of the subject a year ago. Among the most pregnant changes have been those in the education of teachers. Long before the Nazi party came into power its leaders resolved on a rapid unification of the teaching staffs and on eliminating teachers antagonistic to its views. The resultant limitation and precise definition of objectives must have been important factors in the production of a vigorous and efficient system. For teaching in elementary schools, candidates must enter two-year training colleges in which the curriculum includes three main fields: political world-view (*weltanschauliche*) education, scientific study and practical work. Entrance conditions include ability to sing and to play the violin, piano or organ and to instruct in gymnastics and sports. Women must in addition qualify in needlework and home economics. Aspirants to secondary school teaching posts must spend a year in one of these training colleges so as to mix with candidates for elementary school-teaching and so help to unify the profession. The declared purpose of the secondary school is to give preliminary training to especially gifted young people fit to qualify themselves eventually for authoritative positions in the political, cultural and economic life of the nation, and "the constant basis of selection shall be physical fitness, fitness as to character, mental fitness or ability, and national fitness". Conditions of study in the universities, which are subject to close control by the Reich Government, are elucidated by a comparison with the corresponding conditions in the United States.

Educational Finance in the U.S.A.

IT has long been recognized in the United States that there are glaring inequalities between the educational opportunities available in different parts of the country and that the systems of financing the public schools do not take sufficient account of the distribution of financial resources. The resources of many States being insufficient for remedying these inequalities, Federal aid has been invoked again and again in the past five-and-twenty years to correct defects in particular fields—first vocational education and later rural education, teacher training, health work in schools, nursery schools and adult education—but hitherto there has been no comprehensive measure for making good the radical defects in the systems of financing the public schools. The President's Advisory Committee on Education, constituted in 1936, with special reference in the first instance to vocational education, has lately taken this matter in hand, and a pamphlet on "Principles and Methods of Distributing Federal Aid for Education" has been prepared by its research staff (Supt. of Documents, Washington, D.C. 20 cents). It starts with the assumption, based on a study of present costs, that 48 dollars per pupil per annum is not more than enough to pay for elementary and secondary education of tolerable quality in a community enjoying optimum conditions of cost and is insufficient where sparsity of the population or high cost of living enhance the expensiveness of education. It proceeds to elaborate ingenious plans for distributing Federal aid, amounting to upwards of 600 million dollars a year, designed to approximate to the ideal—to each community according to its educational needs, from each according to its means.

Association for the Study of Systematics

THE Association for the Study of Systematics in Relation to General Biology was formed in 1937 (see NATURE, **141**, 163; 1937: **142**, 1069; 1938). Up to the present, the organization of the Association has been deliberately kept as loose as possible, and there has been no subscription. In a leaflet recently issued it is announced that the annual subscription is now five shillings. Further, a fund has been started to provide for expenditure on special purposes. Donors of £5 or more to this fund during the next three years will be designated founder members, and will enjoy for life the privileges of ordinary members. The leaflet also outlines the work so far carried out by the Association. It is hoped that all present members will continue on the new terms and that other biologists will find themselves in sympathy with the aims of the Association. Copies of the leaflet, with forms of application for membership, can be obtained from Mr. H. W. Parker, British Museum (Natural History), Cromwell Road, or from Mr. J. S. L. Gilmour, Royal Botanic Gardens, Kew, Surrey.

Blood Group Tables

THE rapid increase in the literature on blood groups makes it desirable to have a reference work on the subject. Dr. William C. Boyd has supplied this need (*Tabulæ Biologicæ*, **17**, 113–240) by presenting the basic facts in tabular form with a minimal amount of text. All the essential facts

regarding blood groups are given, together with nearly 500 references to the literature. Part 1 is general, its nine sections including tabular treatment of the chemical and serological nature of the agglutinogens *A*, *B*, *M* and *N*; relations to other species; subgroups; heredity of the types; medico-legal applications; relation to disease; and blood groups in animals. Part 2 is anthropological, giving maps of the world distribution of the *A* and *B* and complete tables of the frequency of *A* and *B* as well as *M* and *N* in the various ethnic stocks tested in all parts of the world up to the time of publication. By the use of two kinds of type an attempt is made to distinguish between the more reliable results and those which, because of small numbers (less than 200) or for other reasons, are regarded as less reliable. This compilation of the serological and anthropological facts regarding the blood groups will be of much service to all workers who are interested in this subject.

Position of the Illegitimate Child

THE League of Nations has just published a "Study on the Legal Position of the Illegitimate Child" (London: George Allen and Unwin, Ltd., 1939. 4*s*.). The study opens with a short historical survey of the social aspects of the legislation on the subject in various countries, followed by an analysis of the various legislative provisions respecting civil status, name, nationality and legal domicile, and inheritance rights. The fate of the illegitimate child being closely bound up with that of its mother, a chapter on the unmarried mother's rights is included. The last part of the volume deals with social insurance laws, and welfare measures, including public assistance and preventive health measures.

Television Broadcasting

SIR NOEL ASHBRIDGE gives a review of the progress being made in broadcasting and television in the *Proceedings* of the Wireless Section of the Institution of Electrical Engineers of June. The period under review extends from the end of 1934 until the end of 1938. During this period the number of licence-holders in European countries has increased by more than 60 per cent. The details of the Royal tour in America in increasing the popularity of sound broadcasting have not yet been published, but it is known that the excellent broadcasts of sound and television have greatly increased the popularity of the British Broadcasting Company. The second part of Sir Noel's report deals exclusively with television broadcasting. The great improvements made in the quality of the pictures shown, the great trouble taken by the Government Post Office to locate the position and find out the cause of the interference, when complaints are made, and the remedies they suggest, in many cases completely eliminating the trouble, have satisfied the users in nearly every district. The nominal hours of transmission are now from 3 to 4 p.m.; and from 9 to 10 p.m. The vision transmitter and the studio and control room equipment at the Alexandra Palace Station have been considerably improved; in particular, an improved type of 'Emitron' tube, known as the long-gun type, is now in use for studio work. It is now possible to obtain very satisfactory results with telephoto lenses. Satisfactory reception is possible up to a radius of about thirty miles from the Palace. In exceptional cases reception has been reported up to 200 miles. It is hoped that in the future international standardization with regard to definition and picture frequency may become available, as the absence of a common standard would be a most serious drawback.

A Factory without Windows

A DESCRIPTION is given in the *Electrical Review* of August 4 of a factory without any windows which is being constructed for the Simonds Saw and Steel Co. at Fitchburg, Mass., U.S.A. It is completely air-conditioned and artificially illuminated throughout. It concentrates productive machinery now covering 17½ acres in several plants, into 5½ acres of production space, from which daylight is completely excluded. Lighting fixtures are being installed in 1,440 positions. Each consists of a 100-watt lamp and a simple curved porcelain reflector. These produce an illumination of not less than 20 ft.-candles throughout each room on the working plane. The Company plans to operate the new plant intensively on a three-shift basis, so that the work goes on continuously day and night. Service mains for water, gas, steam, power, light, air and oil are laid between the floors through ducts direct to more than 1,000 machines and furnace positions. The plant has a connected power load of 6,000 horse-power and a total of 4,200 electric outlets giving current for light, machine power, transformers, motor-generators and other units. Dust and exhaust gases are removed through underground ducts, served by thirty dust-removal units. The entire building is air-conditioned by Carrier units and the humidity and temperature controlled through hydrostats and thermostats at four special positions. 'Man-cooler' systems have been provided for the comfort of men working at the furnaces. Air will be circulated through the building at the rate of about 400,000 cub. ft. per minute. It enters the structure through louvres on the end walls of four lean-to buildings which adjoin the main building. Water is obtained from four artesian wells by electric pumping. Air is blown through water-sprays in each of these structures before being distributed.

The All-Welded Hull of H.M.S. *Seagull*

H.M.S. *Seagull* is one of the two minesweepers ordered to be built at Devonport Dockyard as part of the 1936 Naval programme. It was decided that *Seagull* should be built all-welded, whilst the sister ship *Leda* should be constructed in accordance with the normal practice, that is, mainly riveted. The occasion was to be utilized by obtaining a trustworthy comparison between the two methods of construction. So far as was practicable, the thicknesses of plating were left unaltered. The *Seagull* was launched on October 28, 1937, the launching weight

was 313 tons, and the weight of the *Leda* was 338 tons. The welded vessel was commissioned and completed in 1938. Both ships underwent rough-weather trials in Faroe–Icelandic waters for about a fortnight in September 1938.

A PAPER read by A. Nicholls on the *Seagull* to the Institution of Naval Architects on March 31, 1939, and abstracted in *Electric Welding* of June, gives the conclusions to be deduced from the relative costs of building the two ships and their behaviour when on active service. In the discussion on the paper, the Captain of the *Seagull*, who was present, said that he had found the vessel perfectly satisfactory in all respects, although he admitted that he had his doubts when he heard that he had been drafted to an all-welded ship. He had taken her to the region of Iceland for her trials in order to give the vessel a severe test in rough weather, and he testified to the almost complete absence of creaks and groans. He had found that at the same revolutions per min. his vessel was faster than any other in the flotilla, due, he thought, to the saving in weight, and he found that her fuel consumption was considerably less than the *Leda* and the other vessels of the flotilla. On the *Seagull*, which was a minesweeper, there was very little vibration from the winch aft, when drawing in the cables. The author concluded that there are no insuperable difficulties in the way of fabricating a ship's structure entirely by welding and that the redistribution of labour entailed by the new technique does not involve additional expense nor increase the time of building.

New York and London Roads

IT is stated in *Roads and Road Construction* of July that municipal engineers were greatly impressed by the highways followed during the Royal tour in the environments of New York. In particular the West Side Express Highway, the Triborough Bridge, the Henry Hudson Parkway and the Great Central Parkway can be described as magnificent highways. They form part of the system which has been built up during the past ten years near New York. Some of the engineers have returned with plans for bringing certain old-fashioned highways of Great Britain up to date. In New York City and Long Island alone there are more than a hundred miles of parkway and nearly two hundred fly-over crossings. Traffic using these routes is able to reach the heart of Manhattan without a single hold up such as those which delay motorists many times on most routes into big cities of Great Britain. The question is discussed why New York and in a lesser degree Paris, Rome and Berlin have been able to achieve what London has only been able to do in a very minor degree. It is suggested that there are two factors, the first connected with organization and the second with a happy choice of opportunities and times for road building. The development of parkways in the vicinity of New York was conceived and promoted by an independent organization known as the Long Island State Park Commission. This Commission has pursued a continuous policy, and has overcome difficulties in a way impossible to a well-meaning local authority. The opportunity presented by the economic crisis of 1929 and the vast sums afterwards distributed by the Federal Government for the relief of distress and unemployment was taken full advantage of with very happy results. The result has been that New York has now an unrivalled arterial road system. It is hoped that a similar coincidence, namely a strong independent planning authority aided by the central government could, and perhaps one day will, do the same for London.

A 'Hot' Lightning Flash

A RECENT report issued by Science Service, of Washington, D.C., states that the Westinghouse Company has perfected a method, first discovered by P. L. Bellaschi, for producing an artificial electric discharge which imitates natural lightning in its ability to set fire to materials in its path. This form of discharge, which is called 'hot' lightning, is used for the routine testing of all high-tension power transformers sent out by the Company. The volt-amperes required for the test are 1½ million volts, 80,000 amperes. In the previous method used of creating discharge flashes, the heat developed was intense and they had enormously destructive explosive effects on whatever they hit unless it was adequately protected, but they did not last long enough to set fire to combustible targets, only leaving a scorched hole. In the 'hot' lightning stroke, there is a low-amperage, long-duration stroke following the main and 'leader' lightning discharged, similar to natural lightning. The after-stroke of 'hot' lightning generates temperatures only half as high as the main stroke, but it lasts between 100 and 1,000 times as long. The long-duration charge is produced by means of additional condensers or by a transformer from which the charge is 'soaked' through a series of resistance inductance coils in oil and permitted to follow the initial high-current discharge relatively slowly. Demonstrations are shown by the Company of 'hot' lightning, fusing sand in a fibre tube, setting fire to cotton cloth and burning holes through copper sheets varying from one thirty-second to one-sixteenth of an inch in thickness.

Earthquakes during May 1939

ACCORDING to the Bureau central séismologique de Strasbourg, 120 earthquakes were felt by people or recorded by instruments during May 1939. Eight were registered on each of the first and last days, seven were registered on each of the sixth and fourteenth, and only one was registered on each of the seventh, fifteenth, eighteenth and twenty-ninth. The most severe shocks appear to have been those in the region of Akita, Japan, on the first, in California near 29·5° N., 113·8° W. on the second, in the Azores (scale 5 on the island of Santa Maria) on the eighth, in the monts d'Aubrac, France (scale 5) on the sixteenth, in the Adriatic on the twentieth, and at Kalacryta (Greece) where houses were cracked and the intensity reached 8 on the Rossi-Forel scale on the thirty-first, six in all. The last of these appears

to have been the most intense. It was accompanied by a great noise and was followed by twenty-seven aftershocks, seven of which were strong. Next in order of intensity were those of the sixth, felt scale 4 at Calapan in the Philippines, the seventeenth with epicentre in the Pacific south of the Bonin Islands, the eighteenth felt scale 4 at Brig in the Jura bernoise, Switzerland, and the twenty-seventh at Birmanie near 25° N., 95° E. The moderately strong seismic activity in Italy appears to have been continued, shocks having been experienced during May near Romagna, Bologna, Pouilles and Isernia.

International Conference on Flames and Furnaces

AN International Conference on Flames and Furnaces will be held during September 17–20, 1940, at the Royal Institution in London on the initiative of the Institute of Fuel and the British Coal Utilisation Research Association. One purpose of the Conference is to bring the new developments of chemical kinetics and spectroscopy to the notice of engineers and industrialists with the view of accelerating their practical application. The technical programme of the International Conference in 1940 has been prepared by a Committee of thirty engineers and scientific workers. Flames in the internal combustion engine and explosive flames generally are excluded from the scope of the Conference, which will be concerned with the free combustion of gases, liquids and solids in air. The Editorial Committee proposes to invite the authors of papers to collaborate in covering the whole ground of flame and furnace research with the minimum of overlap. Selected authors throughout the world will be asked to contribute papers on specified problems, and early in 1940 the Editorial Committee will co-ordinate the various papers with the help of selected experts in each field acting as chairmen and reporters of the various technical sessions. It is hoped to secure a large attendance of foreign engineers and scientific workers for a conference which should have great practical industrial significance.

International Genetical Congress

THE programme of the seventh International Genetical Congress to be held in Edinburgh during August 22–30 has now been published. Pre-Congress activities include an International Conference on Nomenclature and Terminology of Cytology and Genetics, organized by the International Union of Biological Sciences and the Institut International de Co-operation Intellectuelle, to be held in London during August 14–17. A tour has also been arranged to cover London, Cambridge, Chester and Windermere. During this tour, various institutes at Cambridge will be visited on August 18 and 19, and the Fresh Water Biological Station at Wray Castle, Windermere, will be visited on August 22. Full details of the Genetical Congress to follow at Edinburgh are given in the programme, a copy of which can be obtained from Prof. F. A. E. Crew, Institute of Animal Genetics, King's Buildings, West Mains Road, Edinburgh.

Announcements

THE Clement Cleveland Medal has recently been awarded to Mlle. Eve Curie by the New York Cancer Committee in recognition of her biography of her mother. This is the first time that this distinction has been conferred upon a foreigner.

DR. EUGEN FISCHER, professor of anthropology in the University of Berlin, has been awarded the Goethe prize for art and science by the German Chancellor.

THE following appointments and promotions in the Colonial Service have recently been made: S. F. Barnett, veterinary officer, Kenya; W. J. Gray, veterinary officer, Tanganyika Territory; F. G. Waddington, veterinary officer, Tanganyika Territory; H. T. Dale, meteorological assistant, Nigeria; W. H. C. Belgrave, chief research officer, director of agriculture, Straits Settlements, and adviser on agriculture, Malay States; A. C. Shill, adviser in agricultural marketing and controller of agricultural exports, Malta, chief horticultural officer, Palestine; T. A. Strong, conservator, Malayan Forest Service, conservator of forests, Ceylon.

THE thirty-first annual Autumn Meeting of the Institute of Metals will be held in Glasgow during September 5–8. Further information can be obtained from the Secretary, Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W.1.

THE Association of Special Libraries and Information Bureau (ASLIB) will hold its sixteenth annual Conference at University College, Nottingham, during September 15–18, under the presidency of Sir Harry Lindsay. Further information can be obtained from the General Secretary, Association of Special Libraries and Information Bureaux, 31 Museum Street, London, W.C.1.

THE Swiss Society of Naturalists will hold its one hundred and twentieth meeting at Locarno during September 23–25 in conjunction with the Swiss Medico-Biological Society. The subject for discussion will be the pathology and clinical aspects of hereditary diseases and their diffusion. Further information can be obtained from the secretary, Prof. E. Ludwig, Pestalozzistrasse 20, Basel.

THE eighth Congress of the Institut International d'Anthropologie will meet at Istanbul during September 18–25 under the presidency of Prof. E. Pittard of Geneva, president of the Institute. The meeting will be held in five sections, covering palæontology and archæology, physical anthropology, heredity and blood groups, social anthropology, linguistics and the history of religions.

THE Rockefeller Foundation has established a training fellowship in psychosomatic research tenable at the Tavistock Clinic, of the annual value of £450 available for three years from September 1, 1939. Further information may be obtained from Dr. A. T. M. Wilson, Tavistock Clinic, Malet Place, W.C.1.

LETTERS TO THE EDITORS

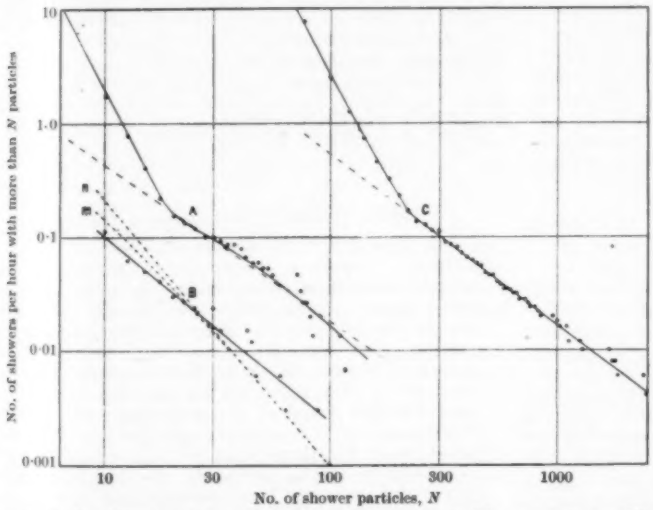
The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 334.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Cosmic Ray Ionization Bursts

COSMIC ray ionization bursts produced by showers of ten or more particles in a small ionization chamber (volume 1 litre) have been recorded at sea-level in Cambridge and, thanks to the hospitality of Prof. P. M. S. Blackett and Dr. H. J. J. Braddick, under 30 m. of clay in London. The data discussed here, curves *A* (150 hours) and *B* (350 hours), are from runs with no lead or other dense shower-producing material above the chamber (the wall of the chamber



was of duralumin, 1·2 cm. thick, so as to avoid as much as possible showers produced by cascade multiplication in the chamber itself). Curve *C* (500 hours) is the result of similar observations at sea-level with a large ionization chamber (volume 175 litres, wall-thickness 0·3 cm. of steel), most of which were published by one of us[1] in 1936, when the method of recording was also described. The curves show the number of showers per hour in which *N* or more particles intersected the ionization chamber; the number of shower particles *N* was estimated on the basis of a specific ionization in normal argon of 90 ion-pairs per cm.

The ionization bursts obtained at sea-level with the big ionization chamber (curve *C*) involve much larger numbers of shower particles than those obtained with the small chamber (curve *A*), and also each curve has a remarkable change of slope at a rate of occurrence about 0·16 per hour. The curves, however, can be superposed fairly closely if the size of the showers in the small chamber is multiplied by 10. We deduce from this approximate proportionality of the *size* of these showers (as distinct from their rate of occurrence) to the areas of the thin-walled chambers used to observe them that they are mostly *extensive showers*, originating in the atmosphere, of the same type as those found by Auger and his co-workers[2] with counters. We should not expect to find exactly the ratio of the areas (approximately 1 : 30) because narrow showers or condensations of rays of cross-section smaller than the area of the large chamber tend to increase disproportionately the bursts in the small chamber.

The bursts which are found underground (curve *B*) must be produced by the penetrating component of the cosmic rays. We have calculated the distribution curve to be expected in the tube station for cascade showers produced by electrons 'knocked on' by mesons using the data given in the paper by Bhabha[4] in which, however, the meson was assumed to have spin $\frac{1}{2}$. We adopted, following Euler and Heisenberg[3], an exponent 1·87 for the integral energy distribution of the mesons originating in the atmosphere. The calculation shows (curve *m*) that the showers resulting from this process alone are nearly sufficient to account for the bursts recorded underground, if we assume that the cross-sectional area of the showers underground is not much greater than the area of the chamber (actually more of the larger bursts are found than are given by this calculation, but the theoretical implications of this discrepancy will be discussed later).

At sea-level a similar calculation (curve *n*) gives much fewer bursts than are observed even if we suppose that the showers are so narrow that all the shower particles in any one burst can intersect the small chamber: but we already know that most of the showers observed at sea-level are at least wider than the large chamber. We therefore conclude that a negligible number of the extensive showers observed at sea-level is produced by electrons knocked-on by mesons. It would seem also that an insufficient number of such showers can be produced by the spontaneous decay of the meson, a process which might be invoked to explain the steeper parts of the sea-level curves.

We think, therefore, that nearly all the showers which produce bursts at sea-level in our thin-walled ionization chambers originate very high in the atmosphere, and that the dual nature of the distribution curve at sea-level (as indicated by the change of slope) is due, not to the existence of showers of two kinds, but to the fact (already noted by Auger[2]) that each extensive shower has a core of closely spaced particles surrounded by a relatively wide

fringe of much more thinly spaced particles able to produce bursts of small size.

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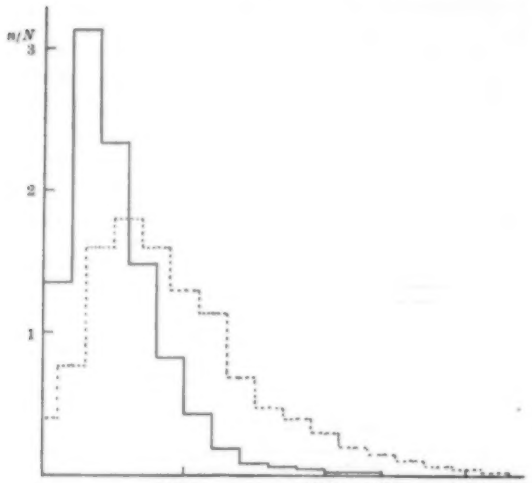
[1] Carmichael, *Proc. Roy. Soc.*, A, **154**, 223 (1936).
[2] Auger, Maze, Ehrenfest and Freon, *J. Phys. et Rad.*, **10**, 39 (1939).
[3] Euler and Heisenberg, *Er. exak. Naturwiss.*, **17**, 1 (1938).
[4] Bhabha, *Proc. Roy. Soc.*, A, **164**, 257 (1938).

β Spectrum of Actinium K

THE radio-element actinium K recently discovered[1] derives from actinium ($Z = 89$) by emission of an α-particle and is placed in the position 87



β-Continuous spectrum of actinium K (full line) and of actinium C″ (dotted line).

of the Mendeléeff table. This element behaves chemically like an alkaline metal, and its period is 21 minutes.

Actinium K has been prepared from an aqueous suspension of lanthanum fluoride containing actinium. The different radio-elements normally deriving from actinium were eliminated by eight successive precipitations of carbonates (lead, barium, lanthanum) with ammonium carbonate. The residual solution was evaporated and calcined. The decay curve of the product obtained by this way shows that the actinium K is radioactively pure.

A fraction of the product was placed on a sheet of mica 20 μ thick or on a sheet of aluminium 5 μ thick and introduced into a Wilson cloud chamber. The method of introduction of the sources and the method of measurement of the β-ray tracks have already been described[2]. 1,600 β-rays have been measured in this way, and the continuous spectrum obtained is represented in the accompanying graph. For comparison the continuous spectrum of actinium C″ has been indicated in the same figure.

The principal characteristics of the spectrum are brought together in the following table, in which are also shown the characteristics of the continuous spectra of actinium B and actinium C″.

	E_p (kev.)	E_m (kev.)	E_M (kev.)
Actinium K	150	265	1·200
Actinium C″	300	470	1·600
Actinium B	400	360	1·000

E_p = energy corresponding to the maximum probability of emission.
E_m = average energy.
E_M = maxima energy.

There have been observed on the photographic plates tracks of a certain number of positons the energies of which vary from 400 to 2,000 kev. The frequency of these positons is ten times higher when the mica sheets are used instead of the aluminium. It is thus possible that the actinium K emits an intense γ-radiation of more than 3,000 kev.; the positons observed would result from the materialization of these γ-rays in the support.

If we admit that the upper limit of energy of actinium K spectrum is 1,200 kev. this point is found on the upper branch of the Sargent curve, corresponding to permitted transitions.

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[1] Perey, M., *C.R.*, **208**, 97 (1939).
[2] Lecoin, M., *J. Phys. et le Radium*, **9**, 81 (1938).

Phase Transitions of Nuclear Matter

THE distribution of capture cross-sections of slow neutrons reveals a surprising concentration of strongly absorbing elements in the region of the rare earths[1]. As has been pointed out[2], this fact may be explained in the simplest way by the supposition that the mean spacings between the resonance capture levels of slow neutrons have a minimum in this region of the periodic system. A more detailed study of the connexion between the distribution of the capture cross-sections and the variation of resonance level density carried out by me seems to prove definitely the non-monotonic shift of the resonance level spacings with a minimum in the region of the rare earths (mean atomic weight 160).

This fundamental fact permits us to draw some conclusions on the properties of excited nuclear matter. The general conception of nuclear excitation due to Bohr[3] enables us to treat excited nuclei as thermodynamical systems. Between the mean level spacing D and the thermodynamical quantities of the nucleus, we have the relation[4]

$$D \sim e^{-S(E,A)}, \qquad (1)$$

where S is the entropy of the nucleus as a function of the excitation energy E and the atomic weight A. From (1) it follows that a minimum of D implies a maximum of S if all thermodynamical quantities are assumed to be continuous. Consequently the nuclear entropy at excitations equal to the dissociation energy of a neutron Q varies non-monotonicly with A. As is well known, Q is fairly constant for light elements but decreases slowly towards the end of the periodic system because of the coulomb repulsion. If all the nuclei at excitations equal to Q were in the same thermodynamical state, then the excitation

energy should be given as a function of the nuclear temperature Θ by a common expression of the form

$$E = \alpha \cdot \Theta^n. \qquad (2)$$

According to Landau and Weisskopf, $\alpha \cong \alpha_0 \cdot A$ and $n = 2$, while according to Bethe $\alpha = \beta \cdot A^{3/2}$ and $n = 7/2$. It may be shown quite generally that there does not exist any power dependance of E upon Θ which agrees with the non-monotonic variation of D exhibiting a sharp minimum at $A = 160$, at any rate if we assume $\alpha \sim A$ or $\alpha \sim A^{3/2}$. Thus the shift of D shows, either (I) that not all nuclei are in the same thermodynamical state at excitations equal to Q, which excitations for the heavier nuclei correspond to lower temperatures, or (II) that the coefficient α in equation (2) is a complicated and possibly non-monotonic function of A, due perhaps to the variation with A of the relative effects of the electrical and short-range nuclear forces.

The first possibility, which seems to us to be the more likely one, means that the properties of excited nuclear matter change at a certain temperature. So we arrive at the *hypothesis of phase transitions of nuclear matter*. This hypothesis is especially attractive since it makes nuclear matter analogous to two other quantum 'liquids', namely liquid helium and the conductivity electrons which also undergo phase transitions at low temperatures. Perhaps phase transitions are a common property of any liquid exhibiting sharply expressed quantum properties, but only the further experimental study of the structure of the nuclear energy spectrum can ascertain whether nuclear matter really exists in two different phase modifications.

The same hypothesis of phase transitions has also been suggested simultaneously by Dr. I. Pomeranchuk. A more detailed discussion of the problem will be published in a paper to appear in the *Physical Review*.

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July 2.

[1] Dunning, I. R., and others, *Phys. Rev.*, **48**, 265 (1935).
[2] Hevesy, G., and Levi, H., *Kgl. Danske Vid. Selskab. Math. Phys. Medd.*, **14**, No. 5 (1936).
[3] Bohr, N., NATURE, **137**, 344, 351 (1936); *Science*, **86**, 161 (1937); Bohr, N., and Kalckar, F., *Kgl. Danske Vid. Selskab. Math. Phys. Medd.*, **14**, No. 10 (1937).
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Effect of Tube-Length on the Visibility of Dust Particles with an Oil-immersion Objective

WHEN a well-corrected oil-immersion objective is used to examine dust particles mounted in a medium such as Canada balsam, of similar refractive index to the oil, the finer particles will give a very similar image on either side of the correct focus, provided the objective is used at the tube-length for which it is designed. We have found, however, that if the dust deposit is mounted dry on the underside of the microscope cover-glass, the image on either side of the correct focus is not the same at the specified tube-length, and in order to obtain the best images, the tube-length must be reduced.

The dust deposits which are collected on a cover-glass by the thermal precipitator are mounted dry in the above way, and examined with a 2-mm. apochromatic oil-immersion objective, *N.A.* 1·30. In these circumstances a considerable fraction of the finest particles are not visible unless the tube-length is reduced until the images on either side of the focus are similar. The necessary reduction in tube-length is of the order of 2 or 3 cm., an amount which is often beyond the tube-length adjustment of an ordinary microscope. An equally satisfactory correction can, however, be obtained by using the adjustable tube-length corrector designed by the British Scientific Instrument Research Association, at the tube-length specified for the objective.

The details of this investigation and of certain other factors which affect the counting of dust particles will be published elsewhere.

We wish to thank the Gold Producers Committee for permission to publish this communication.

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June 29.

Electronic Conduction of Magnetite (Fe_3O_4) and its Transition Point at Low Temperatures

WE have measured the electronic conductivity, down to liquid nitrogen temperature, of a number of iron oxides of the homogeneous 'Fe_3O_4' phase, especially as a function of the exact stoichiometric composition of the material. This seemed of theoretical interest for several reasons:

(*a*) Fe_3O_4 is an abnormally good conductor among the semi-conductors with partially filled lattice bands[1].

(*b*) Fe_3O_4 has a very remarkable crystal structure involving a probably statistical distribution of both Fe^{2+} and Fe^{3+} ions at equivalent lattice points[1].

(*c*) There are indications that Fe_3O_4 shows a transition point in the neighbourhood of 120° K. Anomalies in the magnetic behaviour[2] at 120° K., in the specific heat[3] and in the lattice constant[4] at 114° K., have been found. The magnetic anomaly, however, depends on the mode of preparation[5].

We thought it possible that the statistical distribution of Fe^{2+} and Fe^{3+}, which is a statistical distribution of electrons about the double number of lattice points containing Fe^{3+}, and which accounts for the rather high electronic conductivity of magnetite, would lead to some type of order at lower temperatures. A transition of this kind would probably offer an explanation of the anomalies at 120° K. One would expect such a transition to be very sensitive to the ratio Fe : O in the crystal, since an excess of oxygen (solid solutions of Fe_3O_4 and γ-Fe_2O_3) would imply: (*a*) vacant lattice points in the 16-fold position[6] containing, in stoichiometrically pure Fe_3O_4, 8 Fe^{++} + 8 Fe^{+++}, and (*b*) an increase of the ratio $Fe^{2+} : Fe^{3+}$ at this lattice position; both factors would be unfavourable with respect to order. For the irregularities found by Hilpert and Forrer this would supply an explanation more satisfactory than that put forward by these authors.

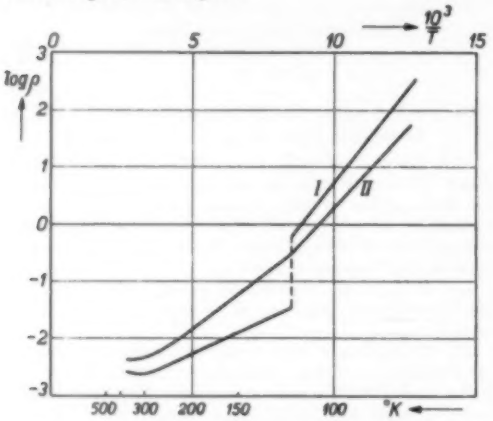
Furthermore, one would expect that such a transition, involving the conducting electrons, would be accompanied by very pronounced effects in the specific resistance at the transition temperature.

Actually we have found a strong discontinuity in the resistivity curves of some Fe_3O_4 samples, and a considerable influence of the ratio Fe : O.

The main difficulty consists in the preparation of

homogeneous crystalline samples of varying composition but all belonging to the Fe_3O_4 or magnetite (spinel) phase[7]. Details of our present technique will be given elsewhere; we used pure oxide pressed into bars and sintered at about 1,300°.

We have found for magnetite with a composition in the neighbourhood of Fe_3O_4 a gradual increase of the resistance (for example, by a factor 10) as one goes from 300° K. to 120° K., a sudden increase of the resistance at approximately 117° K. by a factor of the order 100, and towards still lower temperatures again a continuous increase. Samples containing an excess of Fe_2O_3 in solid solution, however, show a stronger gradual increase of the resistance with decreasing temperature, but a much smaller jump in the curve at about 120° K. or even merely a change in the temperature coefficient of the resistance in that temperature region.



The accompanying graph shows log ρ against $1/T$ for two bars: I with $FeO : Fe_2O_3 = 1 : 1{\cdot}025$, and II with $FeO : Fe_2O_3 = 1 : 1{\cdot}08$. All details of the curves are in full accordance with the picture proposed above for the nature of the transition and our concept of the cation arrangement in the Fe_3O_4 (and the γ-Fe_2O_3) lattice. In further support of our views, we found that sample I shows a distinct drop in the susceptibility for weak magnetic fields at about 117° K., whereas with sample II the corresponding effect is much weaker.

A more complete account of this work, and details about certain hysteresis phenomena accompanying the transition, will be given elsewhere. Measurements at liquid hydrogen and liquid helium temperatures are in preparation.

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[1] Verwey, E. J. W., and de Boer, J. H., *Rec. Trav. chim.*, **55**, 531 (1936); de Boer, J. H., and Verwey, E. J. W., *Proc. Phys. Soc.*, **49**, extra part, 57 (1937); Schottky, W., *Z. tech. Phys.*, **19**, 611 (1938).
[2] Weiss, P., and Forrer, R., *Ann. Phys.*, (10), **12**, 330 (1929).
[3] Parks, G. S., and Kelley, K. K., *J. Phys. Chem.*, **30**, 47 (1926); Millar, R. W., *J. Amer. Chem. Soc.*, **51**, 215 (1929).
[4] Ellefson, B. S., and Taylor, N. W., *J. Chem. Phys.*, **2**, 58 (1934).
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[6] Verwey, E. J. W., *Z. Krist.*, **91**, 65 (1935); cf. also Hägg, G., and Söderholm, G., *Z. phys. Chem.*, (B), **29**, 95 (1935).
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New Iodine and Fluorine Derivatives of Monosilane

WE have recently investigated the reaction between monosilane, SiH_4, and hydrogen iodide at 80° in the presence of aluminium iodide, and have isolated from the products two stable iodides of the formulæ SiH_2I_2 and SiH_3I, which are formed together with silico-iodoform and silicon tetraiodide. The former is a heavy colourless liquid of low volatility (vapour pressure 2–3 mm. at 0°), while the monoiodide is a liquid of boiling point 45·8° and melting point −56·5°, which resembles methyl iodide in appearance.

Both these compounds attack mercury, and, in the case of silyl iodide, the products have been shown to consist of monosilane, disilane, hydrogen and mercurous iodide. It is possible that mercury silyl iodide, $HgSiH_3I$, might be formed under certain conditions, but this compound is certainly less stable than mercury methyl iodide. Silyl iodide in the vapour phase absorbs light of wave-length less than about 2800 A. and is rapidly decomposed by light in presence of oxygen, with liberation of free iodine. Both iodides burn readily in air, with liberation of free iodine and formation of silica.

Silyl iodide reacts with magnesium in the presence of anhydrous ether. Some magnesium is dissolved and the residue is blackened. At the same time a white, ether-soluble compound separates in small amounts and hydrogen and monosilane are evolved. Addition of water results in the evolution of further quantities of hydrogen and monosilane. It is thought that this reaction is due to the formation of a Grignard compound by the silyl iodide. Its stability is evidently lower than that of the corresponding compound prepared from methyl iodide. The numerous synthetic reactions which a compound of the above type would be expected to undergo are being further investigated.

The reaction between dichlorosilane and antimony trifluoride at room temperature, in presence of antimony pentachloride as catalyst, has yielded a new fluorinated silane of the formula SiH_2F_2 (boiling point, − 77·5°; melting point, − 119·1°). This substance is separated with difficulty from silicon tetrafluoride, which is also formed in the reaction by a process of fractional condensation at low temperatures. The fluoride is an inflammable gas which is without action on mercury or glass. Silyl chloride, SiH_3Cl, undergoes a similar reaction with antimony trifluoride, but the products have not yet been completely separated.

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Anomalous Thermal Expansion of Carbon Disulphide at Low Temperatures

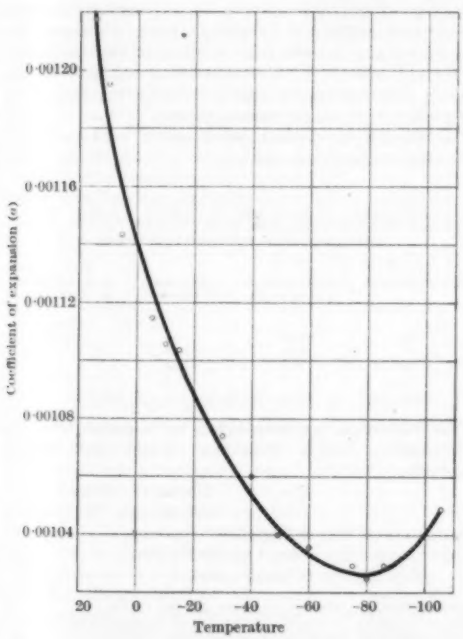
APPLYING the method of Kamerlingh Onnes and I. A. D. Boks[1] and using special quartz apparatus, I have determined the value of the ratio v_t/v_0 for carbon disulphide in the domain of temperatures from + 20° to − 112° C., giving particular attention to the vicinity of − 80°, because at temperatures lower than that the carbon disulphide becomes

muddy, small quantities of sulphur floating in the liquid.

On the basis of these experimental results, I have calculated the coefficient of expansion

$$\alpha = \frac{1}{v}\frac{dv}{dt},$$

and also the variation of this coefficient with temperature, namely, $\frac{1}{\alpha}\frac{d\alpha}{dt}$ for the whole domain investigated. It appears that the coefficient of thermal expansion of carbon disulphide decreases rapidly with temperature, reaches a minimum at − 80° and then increases; the variation of the coefficient of expansion, that is $\frac{1}{\alpha}\frac{d\alpha}{dt}$, diminishes when the temperature decreases and changes sign at − 80° from positive to negative.



The accompanying diagram shows the course of the coefficient of expansion of carbon disulphide, The phenomenon proves certainly the existence of an anomaly in the change of density of the carbon disulphide with temperature. However, neither this phenomenon nor an evident anomaly in the course of the dielectric constant of carbon disulphide[2] necessitates the existence of two liquid phases of this substance, as my investigations on the specific heat have proved that a transformation point does not exist in carbon disulphide.

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[1] Onnes, Kamerlingh, and Boks, I. A. D., Comm. Leiden 170
[2] Isnardi, H., *Z. Phys.*, **9**, 153 (1922).

Physical Characterization of Calf Thymus Nucleohistone

WE have characterized calf thymus nucleohistone, prepared by modified Huiscamp[1] methods, by observation of its sedimentation velocity, sedimentation equilibrium, diffusion, viscosity and electrophoresis. Between *p*H 5·2 and *p*H 9·0 in buffers containing 5 per cent sodium chloride it is monodisperse, and close to *p*H 10·4 is irreversibly transformed into a homogeneous material having a smaller sedimentation constant than the original nucleohistone. In these buffers, the reciprocals of the sedimentation constants of the nucleohistone and its transformation product are linear functions of the protein concentration, and the limiting values of the sedimentation constants for zero protein concentration have been found.

Using the limiting value of the sedimentation constant, and the diffusion constant for dilute protein solutions containing 5 per cent sodium chloride, the molecular weight of the nucleohistone is found to be 2,200,000 in good agreement with the value 2,100,000 determined by sedimentation equilibrium. The sedimentation data indicate that the molecule is highly elongated.

In buffers of ionic strength 0·02–0·04 the molecule is less stable. This is true of solutions in neutral 2 per cent calcium chloride, in which the sedimentation constant is independent of protein concentration, and equal to the limiting value for 5 per cent sodium chloride – buffer solutions. Near *p*H 12 in 5 per cent sodium chloride – buffer solutions a precipitate is formed exhibiting the typical behaviour of a histone.

The electrophoretic behaviour was investigated in buffers of ionic strength varying from 0·02 to 0·08, using both types of Tiselius apparatus. The protein is insoluble in such buffers below *p*H 5, the insoluble region including the isoelectric point, which is estimated to be close to *p*H 4. From *p*H 5 to *p*H 9 the material is negatively charged and homogeneous electrophoretically. Dialysis against tenth normal sodium hydroxide followed by return to lower *p*H shows that the major part of the material is unaltered.

The effective charge of the protein molecule as calculated from titration data is not in agreement with the charge calculated from mobility data alone. This difference is attributed principally to the linear nature of the molecule, a length to width ratio of 50 being indicated.

The marked variation, with the ionic strength of buffer, found for the mobility is of the type required by the Debye-Hückel theory. Theoretical difficulties at present prevent the correlation of the absolute theoretical values with those found experimentally.

The rates of electrophoretic migration varied in the two sides of the U-tube, depending chiefly upon whether the initial migration had been from protein to buffer or vice-versa. It also varied with protein concentration. These variations appear to depend on several factors, including differences in conductivity and ionic strength, *p*H and viscosity on the two sides of the migrating boundary. Corrections determined for conductivity and ionic strength have been found to reduce the magnitude of the variations to about one half.

The molecular kinetic and electrophoretic behaviour of the protein appear to be independent of the method of preparation.

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[1] Huiscamp, W., *Z. physiol. Chem.*, **32**, 145–196 (1901).

Oxidation of Succinate by Heart Muscle

IT is widely held that the oxidation of succinate in animal tissues proceeds in the following manner:

Oxygen ⟷ Cytochrome Oxidase ⟷ Cytochromes ⟷ (*a*,*b*,*c*)

[Succinate ⇄ Fumarate]
[Succinic dehydrogenase].

It is assumed that no co-enzyme or intermediary hydrogen carrier is required to link succinic dehydrogenase to the cytochrome-cytochrome oxidase system[1]. This question has acquired special significance in view of the essential role of the succinic-fumaric acid system in cellular respiration which has been postulated by Szent-Györgyi[2].

Oxidase preparations obtained by the method of Keilin and Hartree[3] from beef heart muscle extracts by isoelectric precipitation catalyse the reduction of methylene blue by succinate under anaerobic conditions as well as the oxidation of succinate by molecular oxygen. Upon repeated isoelectric precipitation, the aerobic activity towards succinate is greatly impaired, whereas that towards hydroquinone is unaltered; in both cases an excess of cytochrome *c* was added.

When phosphate extracts from ground and washed heart muscle are spun in an ultracentrifuge at 384 r.p.s. for 30 minutes, a sediment is obtained which does not catalyse the aerobic oxidation of succinate in spite of the fact that such preparations, even after twice repeated sedimentation, contain cytochrome oxidase, cytochrome *a*, *b* and *c*, and succinic dehydrogenase[4]. The ability to oxidize succinate aerobically is restored by the addition of small amounts of the clear, supernatant fluid obtained by the ultracentrifugation of crude heart muscle extracts. It exerts its activating power also towards oxidase preparations which have been partially inactivated by repeated isoelectric precipitation. The supernatant fluid alone is inactive towards succinate even in the presence of an excess of cytochrome *c*.

The activating principle present in the supernatant fluid is not dialysable, but it is inactivated upon dialysis against large volumes of phosphate buffer, *p*H 7·4. It is partly destroyed when the crude extract is kept at 100° for 10 minutes, and it is precipitated by trichloroacetic acid. The rate at which the principle sediments in the quantity ultracentrifuge at 512 r.p.s. (field at the bottom of the tubes, 69,000 *g*) suggests a molecular weight of the order of 140,000.

The activating principle is not identical with catalase[5] or with aluminium[6]. It may represent the factor the removal of which in the experiments by Stotz and Hastings[7] and in those of Hopkins, Lutwak-Mann and Morgan[8] led to partial or complete inactivation of their oxidase preparations towards succinate. On the other hand, spectroscopic observations show that succinate when added to ultracentrifugally purified oxidase preparations causes the reduction of the cytochromes *a*, *b* and *c* present in such preparations as well as that of added cytochrome *c*. The concept that *the activating principle provides a coupling link between succinic dehydrogenase and the cytochrome-cytochrome oxidase system* would be valid only if it can be shown that the rate of reduction of cytochrome by the incomplete enzyme system is insufficient to bring about a measurable oxygen uptake under the conditions of the manometric experiments. This question, as well as the possible relationship of the activating principle to a flavoprotein[9], is under investigation.

The results of typical experiments will be found in the accompanying table:

Preparation	Time for reduction of methylene blue at *p*H 7·4 and 37°		Oxygen uptake (*μl.* in 60 min.) in presence of 5 mgm. dry weight of enzyme preparation at *p*H 7·4 and 37°; 0·033 mM. hydroquinone and succinate respectively			
	Succinate	Control	Hydroquinone	Hydroquinone + Cytochrome	Succinate + Cytochrome	Succinate + Cytochrome + Activator
1 × ultracentrifuged	—	—	—	—	0	392
3 × ultracentrifuged	3 min.	>60 min.	60	700	18	960
1 × isoelect. precipitated	4 min.	>60 min.	—	720	545	—
3 × isoelect. precipitated	7 min.	>60 min.	—	760	120	—
3 × isoelect. precipitated, after 48 hr. ..	—	—	—	—	0	176

This investigation was aided by a grant from the Jane Coffin Childs Memorial Fund for Medical Research.

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Poly-condensation of α-Amino Acid Esters

UNDER different experimental conditions, there can be obtained from glycine ethyl ester, among other known products, polypeptide esters of various chain lengths.

(1) Solutions of glycine ethyl ester in various solvents, kept either at room temperature or boiling point, deposit precipitates on long standing from which a number of fractions were isolated. The

analytical data of some representative fractions correspond to the following new compounds: dodeka-glycine ethyl ester (solvent: xylene at room temperature); trideka-glycine ethyl ester (solvent: xylene at boiling temperature); heptadeka-glycine ethyl ester (solvent: benzene at boiling temperature).

(2) On passing oxygen or hydrogen through free glycine ethyl ester, the liquid gradually solidifies. After standing several weeks, there were isolated hexadeka-glycine ethyl ester from the oxygen-treated ester and eikosi-glycine ethyl ester from the hydrogen-treated ester.

It appears that, under suitable conditions, glycine ethyl ester can be condensed into linear chains of considerable length. The products are hornlike and practically insoluble even in hot water.

As in the case of other high-condensation products, it should be borne in mind that, although the analytical data and the chemical properties found are in agreement with the formulæ given, they might correspond also to mixtures of hitherto unknown peptide ester homologues of high chain length.

(3) The ability to form linear chains is not confined to glycine ethyl ester; thus alanine ethyl ester (of which the only direct condensation product hitherto known was alanine anhydride) yields under suitable conditions, *inter alia*, condensation products which give a strong biuret reaction and seem to be alanine polypeptide esters.

Systematic experiments on the behaviour of various esters of the different representative amino-acids and their peptides are in progress.

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July 6.

A Chromatographic Study of Lignite

WE find that the Tswett technique is appropriate for the accumulation and isolation of some interesting compounds occurring in lignites. Thus, light petroleum was allowed to percolate through 100 kgm. of lignite (coming from Várpalota, Hungary); the petroleum was sucked through a calcium hydroxide column. In this way the solvent is eliminated and the adsorbent shows different layers, especially under a quartz lamp.

After having eluted the upper half of the column by using alcohol – light petroleum mixtures, we kept the liquid at 0° and observed the formation of water-soluble needles or prisms (15 mgm.). This sample, a potassium salt, is a powerful reducing agent which apparently belongs to the ascorbic – reducing acid – reductone group. Dichlorphenol-indophenol, silver nitrate and selenic acid are instantly reduced at room temperature, but Fehling's solution is reduced only when heated. Iodine is decolourized rapidly in the cold. Ferric chloride produces a dark violet tint on the surface of the crystals.

If the filtrate of the salt mentioned above is washed free of alcohol and repeatedly chromatographed, a second, well crystallized but water-insoluble compound appears (150–300 mgm.) which seems to belong to the triterpene class. It gives the usual sterol reactions but is not precipitated by digitonine. Colourless prisms (from acetone), m.p. 244–247° (decomp., uncorr.); lævorotatory; molecular weight in camphor, close to 400.

The chromatographic investigation of raw extracts of lignite was facilitated by a broad pink zone in the column, which deepens and becomes dark wine red, by elutriation with alcohol. Furthermore, it slowly becomes light yellow when kept in an open flask; this change is rapid, however, if carbon dioxide is introduced. So far we have not succeeded in crystallizing the compound responsible for these phenomena, possibly because it is accompanied by abundant quantities of resin.

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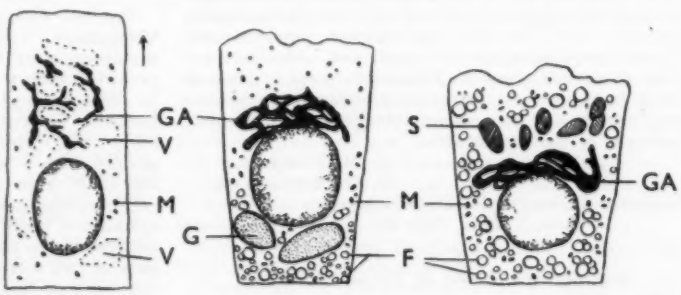
July 5.

Cytology of the Human Uterine Gland Cell

ONLY one type of cell is to be found in the uterine glands. Some of these cells may be ciliated, but are otherwise like the non-ciliated cells. In the proliferative and premenstrual phases (*b*), the normal constituents of these cells are mitochondria (*M*), Golgi apparatus (*GA*), fat (*F*) and glycogen (*G*). No formed secretions otherwise are found. Throughout the entire intermenstrual period, the Golgi apparatus remains juxta-nuclear and confined, but at menstruation (*a*), in the deeper parts of the glands, which are not broken down, a diffuse apparently secretory phase begins (*V*), closely resembling the secretion phases of such glands as those of the epididymis or pancreas islet cells. The surviving postmenstrual uterine gland cells have a clear cytoplasm and small juxta-nuclear Golgi apparatus. Thus, except just at menstruation, no satisfactory evidence for secretion by uterine glands during the normal intermenstrual phases could be found. There is, as has been mentioned, extensive storage of fat (premenstrual) and glycogen, and the lumen of the gland often shows a material which stains well in muchæmatein and mucicarmine, whatever value can be attached to these methods.



a MENSTRUAL *b* PREMENSTRUAL *c* PREGNANCY

But it is at pregnancy (*c*) that a true secretion (*S*) appears in the outer parts of the cells, in front of each Golgi apparatus. This is found in considerable quantities, and is in the form of droplets stainable in iron alum hæmatoxylin, and faintly in osmium tetroxide solution.

Thus we have concluded that two possible phases of secretion may occur in the human uterine gland cells—one just before or during menstruation—as might be concluded by the loosening out and breaking up of the Golgi apparatus, the other quite certainly a 'solid', probably protein secretion, which only appears at pregnancy.

This work was made possible by the Irish Medical Research Council. A fuller account will be published later.

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June 16.

Spontaneous Yellow Fever in Rhesus Monkeys in the Absence of Mosquitoes

BEFORE a satisfactory method of prophylactic immunization had been devised, yellow fever was by no means uncommon among laboratory workers, some 37 cases having been reported. In every instance, those who contracted the disease had been in close contact with material containing either the virulent pantropic or the neurotropic strains of yellow fever virus, and the portal of entry was the skin, conjunctiva or nasopharyngeal mucosa.

During the past winter, two rhesus monkeys, *Macaca mulatta*, kept under laboratory conditions, at an interval of 71 days, have developed and died from spontaneous yellow fever. The monkeys were in two separate animal houses. In the case of the first animal, no other monkey infected with yellow fever had been in the same room for just over three months, while the second animal was in a room where no other infected monkeys had been for nearly six months. No virulent pantropic virus was in use in the laboratory during the period.

The method of infection is at present unknown, but human agency can be ruled out, since the stock of virulent yellow fever virus is under strict control and can be fully accounted for. Mosquitoes were entirely absent from the animal houses, but certain ectoparasites, monkey lice and rat fleas, *Ceratophyllus fasciatus*, were found. In addition, cockroaches, *Blatella germanica*, and a small ant, *Monomorium pharaonis*, were present. Experiments are at present being carried out to determine whether these arthropods were in any way responsible for the spontaneous infection of the monkeys.

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Wellcome Bureau of Scientific Research,
London, N.W.1. July 12.

Reproductive Cycle in *Salmo salar* Linn.

IT is known that in *Salmo salar* Linn. there occurs regularly a very small percentage, possibly of the order of 0·1 per cent, of mature female fish in which discharge of ova may be delayed or does not take place. Such fish are found many months after the normal spawning time heavy with ripe ova. In certain parts of Scotland they are termed 'baggots' or 'baggits' by fishermen.

Beyond the tacit assumption by some that a high rate of mortality supervenes, data of the subsequent behaviour and condition of such fish are scanty.

It is desirable, therefore, to record an instance where a marked degree of recovery appears to have taken place. Part of an ovary and some scales from an outwardly normal 16 lb. spring fish caught by rod in the River Dee near Llangollen in March were sent by Mr. G. M. King to Mr. W. J. Menzies, chief inspector of salmon fisheries, Edinburgh, from whom I received the former specimen, accompanied by the following data:

"The scales show the fish to have been a two years' smolt, and then to have ascended into fresh water as a small spring fish, after approximately two years in the sea, in 1937.

"There is a perfectly good spawning mark for the winter of 1937–38 since when the fish has made approximately a year's normal growth in the sea."

External examination showed the ovary to have an apparently full normal complement of aged ova, opaque and straw-coloured, between which were visible abundan young healthy ova—coral pink in colour—of the type normally present in female fish ascending in the spring. A section of the ovary (see accompanying diagram) showed a compact mass of old (A) and new (A^1) ova, the former in various stages of resorption, most of them shrunken and further distorted in shape by the pressure of the infiltrating new crop.

The general condition of the specimen was consistent with the probability that had the fish remained in the river the young ova would have developed to full maturity by the autumn spawning period. Whether they in turn would have been undischarged remains uncertain pending knowledge of the controlling mechanism in teleostean fishes.

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June 29.

Large-scale Plankton Culture

THE new Oceanographic Institute which Göteborg's Vetenskaps- och Vitterhetssamhälle owes to the munificence of the late Mr. K. A. Wallenberg is provided with a vertical plankton shaft, two metres in diameter and twelve metres deep, which affords facilities for culture experiments on a fairly large scale. Sea water is passed through a sand filter and sterilized by a powerful quartz lamp before entering the shaft from below. It is cooled by means of a refrigerating plant which sends cold brine to two systems of cooling coils, one near the top, the other halfway down the shaft. The illumination plant consists of two mercury lamps of 50,000 lumen each and four sodium lamps of 10,000 lumen, mounted under a large reflector.

In our experiments, the shaft was filled with stratified sea water: an upper column of 28 per mille salinity, 5·5 m. high, to which nitrate, phosphate, silicate and soil extract had been added, and a lower column of 35 per mille salinity which served to raise the column of culture medium to near the top of the shaft. The temperature was kept at about 9° C. in the experiments with phytoplankton and at 6° with zooplankton. With half the set of lamps burning a surface illumination of about 30,000 lux was maintained for 8–10 hours per diem. At 1 m. depth the intensity was reduced to one half or less.

Raw plankton from the fjords or the open Kattegat collected during the spring increase was repeatedly introduced into the culture column and the growth of the population followed by plankton counts. The distribution of suspended particles was also observed by means of a small transparency meter[1]. Water samples from the shaft were inoculated with pure cultures of diatoms, and their growth, which was quite rapid, was recorded photometrically. This proved that the water in the shaft retained its non-toxic properties for at least several weeks.

Of the diatoms, *Skeletonema costatum* showed abundant growth; the number of cells introduced increased from 43 millions to about 3,120 millions, that is, seventy-three times, in the course of twenty-one days. In another experiment the number of *Rhizosolenia alata* f. *gracillima* increased fivefold in eight days while other diatoms remained in good condition during the same time although without increase in number. Several autotroph flagellates, 2–6 μ in length, showed an enormous increase during the first experiment. Convection currents deposited many diatoms on the cooling coils and these, together with the flagellates, formed a green coating around the pipes. It is hoped in future to eliminate this complication.

In later experiments the plankton samples introduced consisted mainly of copepods which thrived well in the shaft, a considerable number remaining alive as long as three weeks. They showed a remarkably uniform phototactic response involving rapid migrations towards or away from sources of light of different intensity.

Experiments are now being undertaken with pure cultures of diatoms in order to investigate the interaction between the plant cells and the surrounding medium under carefully controlled conditions. Later, attempts will be made to grow fish larvæ in the shaft and to study their growth and their distribution under varying light, temperature and salinity conditions.

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[1] Nature, 137, 68 (1936).

Demes: a Suggested New Terminology

In the course of work on the experimental delimitation of botanical groups, the need has arisen for a term which can be applied to any specified assemblage of taxonomically closely related individuals. Such phrases as 'local intrabreeding populations' or 'populations occupying a specific ecological habitat' are cumbersome, and it is felt that a more concise terminology would be useful and, further, would focus attention on certain concepts undoubtedly of great importance in the study of intra-group variation. We propose the term *deme** (from the Greek δῆμος) for this purpose, with appropriate prefixes to denote particular kinds of demes. For example, in a taxonomic group consisting of a number of potentially interfertile individuals all the individuals do not have an equal chance of interbreeding in nature. The tendency is for individuals in close proximity to interbreed more frequently with each other than with individuals at a distance, and thus small, more or less isolated intrabreeding colonies are set up. The distinctive features so commonly exhibited by local communities, for example, of sea plantain, provide evidence of this. These 'breeding communities' are likely to become increasingly important in the intensive study of evolutionary problems and we propose to name them *gamodemes*. It is clear that there are various degrees of isolation between such gamodemes, and when more experimental work has been done on this point it should be possible to devise a method of expressing degree of isolation quantitatively. At present, however, the concepts must remain somewhat vague, as is indicated in the definition given below.

Similarly we propose the terms *topodeme* and *ecodeme* to denote demes occupying specified geographical areas and specified ecological habitats respectively. These demes, however, must not be confused with the categories of experimental taxonomy. For example, the term ecodeme is not a substitute for the experimental taxonomic term ecotype. Ecotypes can be established only after an examination of numerous habitat populations, whereas the term ecodeme has reference to any habitat population irrespective of whether its ecotypic significance is or is not known. Whether the deme concept may entail a system of nomenclature for naming individual demes is a matter for future experience; but we would emphasize that any such system should be kept quite separate, both in form and in function, from systems of taxonomic nomenclature.

It should also be emphasized that these concepts do not necessarily imply the possession of any morphological characters in common between the individuals comprising a gamo-, topo- or ecodeme, other than those characters possessed in virtue of membership of the taxonomic group under consideration. For example, the populations of *Helianthemum polifolium* in Somerset and Devon would belong to separate gamodemes in virtue of the impossibility of their interbreeding in nature, even if no morphological differences could be discovered between them. The same considerations apply to topodemes and ecodemes. For example, two populations of a species from sand-dunes in Devon and in Scotland would belong to the same 'sand-dune ecodeme', even if the morphological differences between them were considerable.

At the same time, there will frequently, of course, be some degree of correlation between demes and intra-specific categories based on morphological criteria. It is hoped that one of the advantages resulting from this new terminology will be to bring out the degree of correlation in particular cases.

The definitions of the new terms are as follows:

Deme: any assemblage of taxonomically closely related individuals.

Gamodeme: a deme forming a more or less isolated local intrabreeding community.

Topodeme: a deme occupying any specified geographical area.

Ecodeme: a deme occupying any specified ecological habitat.

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July 18.

* This word has already been used by Geddes ("Encyl. Brit.", 16, p. 843; 1883) and by Perrier ("Les colonies animales et la formation des organismes", p. 721; 1898), to denote an aggregate of single cells, but so far as we can discover this use is now quite obsolete, and it appears permissible to revive it in another sense.

Effect of the Fungicide 'Granosan' on Atypical Growth and Chromosome Doubling in Plants

IN studying the effect of several insecticides and fungicides upon the procedure of meiotic processes I found that they induce a series of abnormalities, which further lead to production of hereditary variations, thus speeding up the process of the 'degeneration of the pure lines' in various degrees[1,2].

I studied recently the effect of the fungicide 'Granosan' (2 parts of CH_3CH_2HgCl + 98 parts of talc) upon mitosis. Treating germinating grains of *Secale cereale*, *Triticum vulgare*, *T. persicum*, *T. durum*, *T. polonicum*, and *T. ægilopoides* with 0·5–0·1 per cent Granosan (that is, 0·01–0·002 per cent ethyl mercury chloride) for 3–6 days (some experiments were continued for three weeks) swellings of the root tips and of the whole seedlings occurred. Studying these seedlings cytologically, I found that the agent has induced abnormal mitosis similar to those induced by colchicine and acenaphthene, namely, failure of (rather abnormal) achromatic figures, chromosome multiplications, multinucleations, and formation of large amœboid nuclei.

Occasionally chromosome doubling and large nuclei in the root tips of similarly treated seedlings of *Pisum sativum* occurred; but amœboid nuclei and multinucleations were not so frequently observed. Consequently, Granosan is a more effective agent in treating leguminous plants than acenaphthene. Germinating seeds treated by Granosan for induction of polyploidy are not attacked by fungi, while those treated by colchicine are usually severely attacked.

The induction of atypical growth and chromosome doubling in Graminæ by Granosan, and in a degree of colchicine and acenaphthene, shows that these biologically active properties of the compounds have nothing to do with the cyclic or heterocyclic structures of the molecules of the active compounds.

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[1] Kostoff, D., "The Degeneration of the Pure Lines", Sofia (1930).
[2] Kostoff, D., *Bull. Soc. Bot. Bulgarie*, **4**, 87–92 (1931).

Points from Foregoing Letters

H. Carmichael and C.-N. Chou have measured cosmic ray ionization bursts underground and have calculated the rate of production of such bursts by mesons; they obtain fair agreement. Their measurements of bursts at sea-level, however, provide evidence of wide cosmic ray showers which originate in the atmosphere but evidently do not come from mesons. These wide air showers may be of two kinds.

In order to explain the anomalous dense spacing of nuclear resonance levels in the region of the rare earths, I. Gurevich suggests that nuclear matter undergoes a phase-transition at a certain temperature in a similar way as liquid helium and conductivity electrons in metals.

E. J. W. Verwey finds that the transition point in magnetite at about 120° K. is of electronic nature, and is probably connected with an order-disorder transition in the distribution of 8 electrons about 16 equivalent metal ions in the unit crystal cell. When a sample of pure, sintered magnetite is cooled a sudden increase of the electrical resistance by a factor of the order 100 occurs at the transition temperature; this phenomenon can be suppressed, however, by an excess of oxygen in the lattice.

In his investigations of the change in the coefficient of expansion α of CS_2 at low temperatures (+ 20° to − 112°), J. Mazur finds that the minimum of α is reached at a temperature of −80° C.

R. O. Carter and J. L. Hall find the molecular weight of calf thymus nucleohistone to be approximately 2,100,000 and the molecule to be highly elongated. The protein is electrophoretically homogeneous but the effective charge of the molecule calculated from titration data is not in agreement with the charge calculated from mobility data alone.

Contrary to our present views, Kurt G. Stern and Joseph L. Melnick have found that a heart muscle preparation containing succinic dehydrogenase, cytochromes *a*, *b* and *c*, and cytochrome oxidase is unable to catalyse the oxidation of succinate by molecular oxygen. When an activating principle of protein nature is added to the system, the aerobic activity towards succinate is restored.

M. Frankel and E. Katchalski state that certain amino acid esters (glycine ethyl ester, alanine ethyl ester) can under suitable conditions be condensed to hitherto unknown polypeptide esters of considerable chain length.

L. Zechmeister and O. Frehden find that the accumulation and isolation of two interesting compounds can be carried out by submitting a petroleum extract of lignite to the chromatographic analysis: one, showing high reducing power and belonging to the ascorbic acid-reducing acid-reductone group, and another, which seems to belong to the triterpenes.

J. B. Gatenby and Olive E. Aykroyd have shown that curettings from early interrupted pregnancy cases may be recognized by the presence of large secretion granules in the uterine gland cells.

G. M. Findlay and F. O. MacCallum state that spontaneous yellow fever has occurred, at an interval of 71 days, in two rhesus monkeys, *Macaca mulatta*, kept under laboratory conditions in separate animal houses. Mosquitoes were not present, but certain arthropods, which must be considered as possible vectors, were found.

An instance is recorded by R. M. Neill of a female salmon (*S. salar*) returning to sea, after spawning migration with matured ova undischarged and after a year's normal growth in the sea, reascending into fresh water; when the ovary showed in addition to undischarged ova in an advanced stage of resorpton, a new crop of young developing ova normal to fish ascending in spring.

H. Pettersson, F. Gross and F. Koczy describe a vertical plankton shaft which affords facilities for culture experiments on a large scale. Satisfactory results were obtained with both phyto- and zooplankton.

RESEARCH ITEMS

Skin of Rebirth

DR. MAURICE CANNEY has collected a number of examples of the magical significance of animal skins among modern primitive peoples and compares it with belief current in ancient Egypt (*Man*, July 1939). Among the Bantus, children before reaching the age of circumcision had to go through a ceremony, the name of which means "to be born again". The child was invested in part of the skin and skin of the big stomach of a male sheep which had been killed by the father. It then had to go and lie on a bed by its mother and cry like a new-born infant. In funeral ceremonies of the elders, burial was not complete without a skin of a sheep or a bullock if the family could afford it. The corpse was laid out in the prenatal position and the skin, hair upward, laid upon it. Among the Ila-speaking peoples a corpse was first put in three dry skins. A great slaughter of beasts took place at a funeral. Five large oxen were called the wrapping-up cattle, because their skins were laid in the bottom of the grave, and wrapped around the corpse arranged in the prenatal position. Among the Lango it is noted that the corpse was carried to the grave in the sleeping hide of the deceased, and it was buried with him. Over the grave a sheep was killed for the funeral meal. The skin of this was worn afterwards on the head of the nearest relative. This evidence suggests the survival of an idea prevalent in ancient Egypt. In the legend of the Wandering of Isis in the Delta the goddess said to Horus *inter alia* that he was "the son of him that is in Mesqet" this being the name of the bull's skin, in which the deceased was placed to secure for him the new life. In the Egyptian religion the most important of the rites of initiation was one called the mystery of animal rebirth; and in it as depicted in the Theban tombs a priest is shown in a sleigh crouching under a skin in the position of a fœtus. When he comes forth from the skin, he is supposed to be reborn. Skins have the same significance in belief in India.

The Last of the Dinosaurs

THE Smithsonian Institution reports that in Upper Cretaceous rocks in central Utah explorations by palæontologists from the Institution have revealed considerable fossil skeletal remains of titanosaurs. The discovery is interesting because, although the presence of these gigantic plant-eating dinosaurs had been known from a wide area, including India, Indo-China, Madagascar, France and South America, only two bones found in New Mexico in 1921 had indicated their habitation of North America, until the Utah finds of the past two summers. Moreover, they and the horned dinosaurs and 'duck-bills' also represented in the same beds were amongst the latest to survive of the giant reptiles, and although no break has been found in geological conditions between these Upper Cretaceous beds and the succeeding Palæocene sufficient to suggest a cause for their sudden disappearance, there is a possibility that the formation constitutes a bridge between the closing of the great reptilian age and the dawn of the mammalian epoch. It may therefore yet yield a clue to two of the most momentous steps in the evolution of animal life.

Cytology and Taxonomy of Calochortus

THE genus Calochortus is a difficult one for systematists. By combined cytological and morphological study, J. M. Beal (*Bot. Gaz.*, **100**, 528–547; 1939) has defined the limits of some sections of the genus. Of 28 species, those with $n = 10$ and capsules winged on the angles are placed in Eucalochortus, while the remainder with a basic chromosome number other than 10 are placed in Mariposa, except one, *C. plummeræ*, $n = 9$, which is placed in Cyclobothra. Seven is considered to be the basic number of Mariposa and possibly of the genus. Evidence is given suggesting ways in which other chromosome numbers have been derived from seven.

Food Value of Broccoli

E. Vanstone and C. E. H. Knapman (*J. Pom.*, **17**, 85; 1939) have determined the amounts of nitrogen, phosphorus, potash and lime removed from the soil by Roscoff broccoli grown in different localities on commercial farms and on experimental plots at Seale Hayne. They found that the composition of the plant was approximately constant regardless of location and manuring. The average amounts of minerals removed from the soil per acre were: potash 240 lb., nitrogen 204 lb., lime 110 lb., and phosphoric acid 70 lb. Good quality curds differed from those of inferior quality ('soft curds') by having a higher percentage of potash and lower nitrogen. Plants sown in April and transplanted in June, grew most rapidly during September, October and November and matured the following April. Minerals were absorbed continuously throughout the growing period. The composition of the dry matter of the curd was compared with that of dried milk and found to be higher in protein (40 per cent), higher in ash (12 per cent) and equal in carbohydrate (36 per cent). The curd is evidently a highly nutritious food, rich in protein and mineral matter but deficient in fat. The leaves of the broccoli plant account for half the total dry weight, and though these are not used for human consumption they represent a valuable food for cattle, especially for dairy stock. They compare favourably in protein, oil and carbohydrate content with palm kernel cake and young grass, and are superior to these in that they contain less fibre and more mineral matter.

Nodule Organisms of the Leguminosæ

THE discovery, towards the end of last century, of the peculiar symbiotic nitrogen metabolism of leguminous plants was quickly followed by the knowledge that each plant species required a particular strain of the appropriate organism, *Pseudomonas radicicola*. This led in practice to the tabulation of plant-bacteria groups, but certain difficulties arose, and necessitated a re-survey of the whole question. J. K. Wilson undertook this task upon an adequate scale, and his results have recently been published (*Cornell Univ. Agr. Exp. Sta. Mem.* 221, Ithaca, U.S.A., March 1939). More than 12,000 tests were made with about 200 plant species from 70 genera, and 32 strains of the organism, all made under sterile conditions. This imposing volume of experimental

result leads to the conclusion that plant-bacteria groups are likely to be somewhat tentative. They should still be useful in practice, but several plants which had not previously been assigned to a group could be placed in the present investigation, in as many as twelve of them. Other plants, moreover, will symbiose with almost any of the strains. *Phaseolus coccineus* and other species have symbiosed simultaneously with four or five strains of the organism. Morphological studies have also been prosecuted, and it is further suggested that organisms with restricted range of symbiosis are predominantly monotrichic, whereas those with extended symbiosis include also forms with several flagella.

Structure of Proteins

THE picture of the structure of proteins proposed by Emil Fischer regards them as polypeptide chains, and this has been extended by the assumption of hydrogen bonds and other weak interatomic forces acting between chains and their parts. The so-called cyclol hypothesis postulates hexagonal rings resulting from the transfer of hydrogen atoms from secondary amino to carbonyl groups with the formation of single C—N bonds. In a comprehensive paper, L. Pauling and C. Niemann (*J. Amer. Chem. Soc.*, 61, 1860; 1939) review several lines of experimental evidence bearing on this question. X-ray work is not regarded as providing satisfactory evidence for the cyclol theory, and several investigations have provided strong (but not rigorous) evidence for polypeptide chains in fibrous proteins. The great complexity of proteins, however, makes it unlikely that a complete structure determination by X-ray methods is possible. Heats of combustion and bond energies show that the cyclol structure cannot be of primary importance for proteins; a cyclol structure would be considerably less stable than a polypeptide one. Interatomic distances in the cyclol structure have improbable values, and the presence of large numbers of hydroxyl groups postulated in it seems to be negatived by experiments on the acylation and alkylation of proteins. No simple substances with the cyclol structure have been synthesized so far. Among the arguments used in favour of the cyclol hypothesis, that of the total number of amino acid residues per molecule, and a further modification involving imino acids, are said to lack force. Recent evidence shows that proteins in films have the polypeptide structure. The authors give a concise summary of their own views on the protein problem. They believe that the chains or rings contain many amino acid residues, usually several hundred. A native protein molecule possesses a definite configuration involving the coiling of the polypeptide chain or chains in a definite way, brought about mainly by hydrogen bonds. A wide range of configurations is regarded as probable. The number of each individual amino acid residue and the total number of all amino acid residues in the molecule can be expressed as powers of the integers two and three, and there is perhaps some significance in the number 288 of residues in the simple proteins.

Reactions of Methyl Radicals

AN extension of previous work on the reactions of methyl radicals has just been published by H. S. Taylor and J. O. Smith (*J. Chem. Phys.*, **7**, 390; 1939). Methyl radicals, produced by the photolysis of mercury dimethyl, were allowed to react with deuterium, ethane, normal and *iso*-butane, and neopentane, and the amounts of methane and ethane formed were determined. The plot of the logarithm of the rate of formation of methane against 1/temperature (abs.) is a straight line for all the reactions. To obtain a satisfactory mechanism for the reaction between mercury dimethyl and hydrogen or deuterium proved troublesome because of the number and variety of facts which the mechanism was required to satisfy, but it has been successfully accomplished. The most important of these facts are that both in the absence and in the presence of hydrogen or deuterium the formation of ethane remains unchanged; formation of methane increases with temperature and so does the rate of decomposition of the mercury dimethyl; formation of ethane shows first-order dependence on light intensity, whilst formation of methane shows an order between one-half and the first power, tending to the first power with increased temperature; packing the vessel, at 200°, cuts down the amount of methane formed but does not affect the amount of ethane; and the rate of decomposition of mercury dimethyl is independent of its concentration. For the interactions with the hydrocarbons the suggested mechanism is (i) $CH_3 + RH = CH_4 + R$; (ii) $R + CH_3 = RCH_3$; (iii) $CH_3 + CH_3 = C_2H_6$. From the rate of formation of methane the following activation energies for the reactions of methyl radicals with hydrocarbons, assuming zero activation for ethane formation, have been deduced: ethane and neopentane, 8·3; *n*-butane, 5·5; *iso*-butane, 4·2 kg.-cal. The differences in activation energies are attributed to differences in bond energies, particularly because of the closely analogous differences observed by Kistiakowsky in the heats of hydrogenation of substituted ethylenes.

Motion Pictures of Small Chromospheric Flocculi

SOME interesting facts on chromospheric phenomena are given by Robert R. McMath in a recent paper with the above title (*Mon. Not. Roy. Astro. Soc.*, 99, 7; May 1939). In August 1938, Mr. H. E. Sawyer was taking motion pictures of a dark hydrogen flocculus at the McMath-Hulbert Observatory, and displaced the second slit one half angstrom towards the violet with the object of registering a portion of the flocculus which showed velocity in the line of sight when examined in the spectrohelioscope. Sufficient exposures were made to provide a run on the screen when the spectroheliograms were shown by means of a motion picture projector. The motions of the small, dark flocculi were clearly seen, and it was obvious that a motion picture of the fine chromospheric detail had been secured. When the experiment was repeated with the second slit displaced one half angstrom towards the red, the pictures showed the same phenomena, but not so definitely. The author describes the surface of the sun seen in these pictures as like "an ocean viewed directly from above, and covered completely with short and choppy billows in a constant progression of irregular growth and recession". Accurate determination of the mean life-period of the flocculi involves careful identification of the markings measured on successive motion picture frames. For this purpose a high speed in taking individual frames is necessary, perhaps as high as eight per second, and it is hoped that sufficient material will be at hand this summer to undertake such research.

THE LEONARDO DA VINCI EXHIBITION AT MILAN

THE Exhibition of Leonardo da Vinci (1452–1519) which has been staged in the Palazzo dell' Arte in Milan is a truly comprehensive and magnificent testimony to the many-sided activities of the great master. Endeavour has been made not only to collect exhaustive examples of his multifarious interests, but also to illustrate his personal environment and record, and thus ensure a finer appreciation of the man himself. There are galleries devoted to documents connected with his life-history, to his library, and to portraiture of him both in painting and sculpture. To provide background, other rooms show the work of his masters, his contemporaries at Florence and at Milan, and the pupils of his school.

In the Hall of Honour there are numerous drawings and designs of da Vinci, and in other galleries examples of his sculpture and some copies of his paintings. This splendid symposium, generously subscribed from public and private collections in many countries, manifest his superb mastery in drawing and design.

None the less staggering are his manifold achievements in the field of science. Anatomy and botany each occupy a gallery ; these two subjects of natural science are known to have stirred Leonardo deeply, and the far-seeing results of his investigations are well portrayed.

In the realm of physics and mathematics he was ahead of his age. In several rooms there can be seen models and charts and diagrams of his work on astronomy, optics, mathematics, or again on geology and geophysics. His service under various masters necessitated his turning his mind to architecture and town-planning : a series of fine models and drawings bear testimony to his power of blending a balanced and artistic outline with the practical needs of utility.

It is perhaps natural that much space in the exhibition has been devoted to a record of his engineering qualities. Two hundred models, some full size and some on a reduced scale, have been faithfully reconstructed from da Vinci's own elaborate notes, drawings and dimensions in the "Codice Atlantico" and other documents, and bear ample witness to his amazing versatility.

The flight of birds aroused his keenest interest and study, and he was convinced that man could achieve flight with mechanical aid : the models and records of his designs in this direction are indications of his insight into the future. Similarly his realization of natural forces prompted his investigations of the action of the waves and the winds : his designs for ships, with single or double hulls, and for paddle steamers, were the outcome of this research and betray a mind more fertile and far-seeing than any of his contemporaries.

Innumerable models and drawings give evidence of da Vinci's ingenuity and power of invention in mechanical devices of almost every kind. Pumps and all manner of hydraulics are notable examples, and one is tempted to run the gamut of all his varied achievements in mechanical engineering : it must suffice, however, to mention only a few examples, such as a printing-press, differential gear, cranes, water wheels, fire-escape ladder, belt-driven machines, in order to disclose his grasp of mechanical forces and the multifarious uses to which they could be put.

The wars of the period inevitably drew a man of his ability into their net, and his genious as a military engineer made his services invaluable to his chiefs. His study of ballistics stood him in great stead, and models of his multiple gun, bridges and fortifications are records of the adaptability of his great knowledge. It only remains to say that space has not been stinted at the Exhibition : the lay-out is good and modern. Skilful use has been made of murals and drawings and appropriate wall or ceiling decoration : the result is not only attractive but intensely interesting. The Exhibition remains open until October 1.

UNIVERSITY STATISTICS IN GREAT BRITAIN, 1937-38*

THE returns recently published by the University Grants Committee show that the total number of full-time university students in Great Britain continues to diminish. A gradual decline has been continuous since 1934 and would have been more noticeable after 1935 but for a simultaneous increase in the number of students from overseas. The actual figures are as follows :

	From overseas	Other full-time students
1933–34	4,670	46,067
1934–35	4,653	45,985
1935–36	4,718	45,811
1936–37	4,989	44,700
1937–38	5,096	44,093

The decline has been most marked in Wales, where the number fell by 15 per cent between 1935 and 1938, after a rise of 18 per cent in the preceding four years. The falling off in the Scottish universities, to which attention was directed in the Grants Committee's last quinquennial report (for 1929–35), has continued but was very slight last year when, moreover, admissions showed a sharp rise of 248. Admissions in Great Britain as a whole showed a rise of 295 following decreases of 423, 296, 374 and 189 in the four preceding years.

Distribution of the whole body of full-time students over the different subject groups during recent years is shown in the accompanying diagram. It exhibits a remarkable upward trend under the head of medicine (including dentistry). During the years in question the proportion of women students of medicine and dentistry increased from 12 to 14. Research and other advanced studies continue to occupy an increasing number of full-time students. The years 1929–35 showed an increase of no less than 35 per cent in

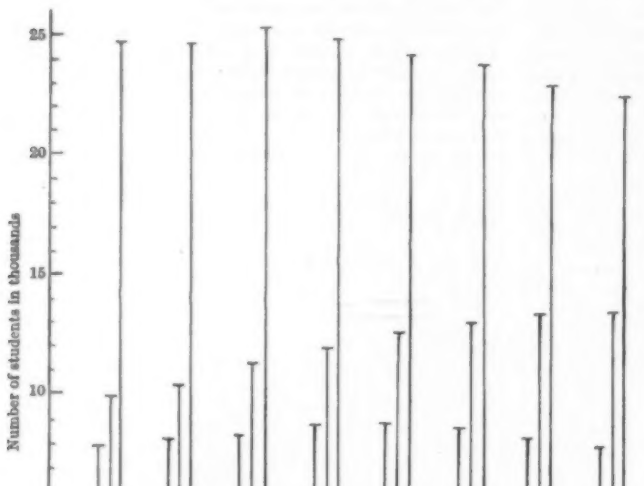
* Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1937–38. Pp. 28. (London : H.M. Stationery Office, 1939.) 1s. net.

their number, although in the preceding quinquennium there had been practically no increase. Since 1935 there has been a further rise of 5 per cent and they now constitute more than 6 per cent of the total of all full-time students.

Conditions of residence of full-time students are indicated by the following figures: residing in colleges and hostels, men 8,124, women 4,314; in lodgings, men 14,190, women 2,163; at home, men 15,576, women 4,822. The subject was discussed at considerable length in the quinquennial report 1929–35 and the Commissioners extolled the value of properly equipped and managed halls of residence. Recently their opinions have been echoed in the National Union of Teachers' report on the training of teachers, which points out that for prospective teachers who live at home while taking the four years approved course, university life becomes little more than a prolongation of school-days, while lacking such elements of community life as school provided, and where the journey between home and university is a matter of hours, as is often the case, these precious years tend to be squandered in an incessant rush of trains, lectures and preparation of work. The report goes so far as to recommend that *all* students attending this course should live either in a residential college or a college hostel, and that residence fees should be brought within the means of the poorest student. The following table shows that Sheffield and St. Andrews are the only universities in which there has been any marked advance in this respect since 1935:

Students in colleges and hostels.

	Increase or decrease since 1935	Percentage ratio to all full-time students 1935	1938
England (excluding Oxford and Cambridge)	+112	18·9	19·8
Wales	−26	15·3	17·2
Scotland	+61	8·2	9·1
Total	+147	15·8	16·9
Reading	+21	68·3	76·4
Bristol	−17	37·2	35·9
Durham	−18	31·0	32·2
Leeds	−12	23·4	21·1
Manchester	−56	20·7	20·9
Sheffield	+82	9·5	20·2
Birmingham	+1	12·5	13·7
London	+54	12·0	12·4
Liverpool	−3	10·1	10·4
St. Andrews	+64	24·0	31·2
Edinburgh	−31	13·9	13·7
Glasgow	+21	3·5	4·3
Aberdeen	—	—	—



Groups of five vertical lines represent number of students in one academic year in agriculture, technology, pure science, medicine and arts respectively, reading from left to right.

NUMBER OF STUDENTS ARRANGED BY SUBJECTS.

The most interesting feature of the returns is their inclusion for the first time of information as to the educational origins of newly admitted students. This significant innovation takes the form of a tabular statement of full-time graduating and diploma students entering for the first time in 1937–38, (i) whose homes were in the United Kingdom, and (ii) how many of these began their education in a public elementary school. From Oxford and Cambridge and the Institute of Education, London, this information was not forthcoming but will be given in future returns. The following table summarizes the figures for all the other institutions:

	(i)	(ii)	Percentage ratio (ii) to (i)
University of London	2,905	822	28·3
England	6,071	[2,761	45·5
Wales	674	600	89·0
Scotland	[2,221	1,371	61·7
Great Britain (Total)	[8,966	4,732]	52·8

Women included in the figures under (ii) were: 252, 697, 166, 406 and 1,269 respectively.

Although the figures are far indeed from indicating approximation to equality of educational opportunity, they show that there has been much progress since the Cross Enquiry Commission of fifty years ago was told by a witness under examination as to the prospects of a public elementary school pupil ever reaching a university: that it would be next to expecting him to take wings.

By way of supplement to this information, the Grants Committee publishes a table showing the proportion of 'assisted' to other full-time students, this expression implying assistance from outside sources (that is, other than personal and private), namely, scholarships, exhibitions and other awards and allowances providing wholly or in part for the payment of fees. The percentages are: Oxford and Cambridge, 44·7; London, 26·4; England, 38·5; Wales, 58·8; Scotland, 45·7; total, 41·9. The percentage of assisted women students was 46; of men 40.

PROGRESS IN BUILDING RESEARCH

PROGRESS towards the solution of many building problems is recorded in the annual report for 1938 of the Building Research Board recently issued by the Department of Scientific and Industrial Research (London: H.M. Stationery Office. 3s. 6d. net). One of those pressing most urgently for investigation is that of sound transmission in buildings, and in this sphere of activity the report claims that the position of these inquiries has been very much advanced during the past year. It has been made clear that in buildings with a normal continuous rigid construction it is virtually impossible to obtain a higher degree of sound insulation between two neighbouring rooms greater than that obtainable with 9-inch brick walls on a concrete floor resting on sound insulators. Reviewing, therefore, the results of experiments in the small steel frame building at the Research Station, in which various types of construction can be tested, it is claimed that practical suggestions for construction to cut down sound transmission can now be advanced.

Special interest is attached to the work done in the preparation of artificial pozzolanas. The value of the European natural pozzolanas has long been known, the name being derived from the volcanic dust from the region of Pozzuole which the Romans used in their mortars. These natural earths or volcanic tuffs have the ability to combine with lime and thereby to produce a hydraulic set which gave to the ancients a cementing material suitable for sea-walls, aqueducts and the like. A more important development is their use with Portland cement which, when used in soils containing sulphate salts, suffers serious deterioration from chemical attack. The work of the Research Station has provided the method whereby artificial pozzolanas have been produced from certain clays and from refuse from the Scottish shale oil industry. Used with cement mortar these materials greatly increase its resistance to sulphate attack, but somewhat diminish its early strength. Both natural and artificial pozzolanas have been included in tests on the corrosion of steel reinforcement in concrete piles exposed to sea-water, which are being carried out in conjunction with the Sea Action Committee of the Institution of Civil Engineers. The report notes that the manufacture of these materials is now beginning to be undertaken by the cement makers.

The spray method of cleaning buildings has been applied with success and its efficacy in particular circumstances has been the subject of experimental investigations. Most noteworthy among the latter is the cleaning of the Admiralty Screen in Whitehall, a Portland stone structure about 150 years old and the work of John Adams. Being almost completely soot-blackened it offered a severe test of the efficacy of the treatment.

A new branch of the work deals with ventilation problems, which are especially worthy of study in the interests of health and comfort. It is a subject which has received little attention and not much is known as to the distribution of air in buildings provided with the different mechanical ventilation or air-conditioning methods of to-day. The relative degree of purity of air supplied by upward or by downward ventilation is of considerable importance. The work in hand is primarily directed to the development of methods of testing the efficiency of different types of air filter, for with an inefficient filter there may, when air is re-circulated, be an accumulation of impurities in the building affected. The extension of the work in this section is commended to the interest and backing of the organizations concerned. With the help of the British Electrical and Allied Industries' Research Association experiments were made possible on the ventilation in a room when warmed by different methods.

Among the new apparatus described in the report is a rain gauge, used for experiments on damp penetration, which records the amount of rain received from different points of the compass. There are also described a machine for comparing the slipperiness of different types of floor and an apparatus for measuring the efficiencies of various treatments for minimizing the condensation of water on walls.

RADIO-TELEGRAPHY AND RADIO-TELEPHONY

IN the *Proceedings* of the Wireless Section of the Institution of Electrical Engineers of June there is a review of the progress made in radio-telegraphy and telephony during the last few years by C. E. Rickard of Marconi's Wireless Co., Ltd. As this period has been notable for steady advance rather than outstanding invention, he was faced with two main problems (1) where to start and where to finish in relating this progress, and (2) what relative importance to attach to the numerous branches and ramifications which together make up the science, art and practice which provide the subject-matter of such a review. Progress in the science of radio covers advances of knowledge in theory and technique, but progress in the art, although dependent on progress in the science, also depends largely upon the commercial application of such improvements as may have been made in the past. In addition, the commercial aspect of progress in the art of radio, although mainly controlled by economics, is also governed by the application of international regulations in the practice of radio communication. Seeing that a new international agreement has recently been reached at Cairo, the occasion to discuss the effects of the 1938 convention is opportune.

The recent plenary International Conference to review the Telecommunications Convention, and General Regulations made at Madrid in 1932 was

held at Cairo in the spring of 1938. The Conference commenced on February 1 and was opened by H.M. King Farouk at the Heliopolis Palace Hotel. The work of the Conference entailed much study of the business aspects of telecommunication, including telegraph and telephone tariffs, communication procedure, traffic routing, and many other factors in the art and practice of telecommunication in all its branches. It also included a very important item, the revision of the Madrid General Radio Communications in the light of present-day needs, resulting from progress made during the past five years. This progress had led to increasing congestion in the ether, owing to the tremendous expansion of radio services during this period. Of particular importance was (*a*) the growth of aerial transport, of which radiocommunication in all its forms is a most important ancillary service; (*b*) the ever-insistent demands of broadcasting, which have gathered added strength from the increasing weight of public opinion and political activity; (*c*) the further development of the marine services in all branches, but especially in the short-wave trawler telephony and radiogoniometric services.

The actual modifications made at Cairo, although large, were much smaller than expected. These were mainly due to the modifications made in the allocation of frequencies to the various services, and to the tightening up of the regulations in respect to the frequency tolerances, attributable to the various types of transmitter corresponding to the different services they perform.

The first real allocation of frequencies was made at Washington in 1927 and was largely the result of experience gained during the Great War and subsequent years. It was a tentative effort to distribute the available frequencies among the claimants whose services at that time had begun comparatively recently, namely, radiogoniometry, broadcasting, radiotelephony for small ships, short-wave point-to-point services and amateur activities. The frequency allocations thus adopted were largely influenced by the positions in the radio frequency spectrum required by these new services. At Madrid the frequency allocations were slightly modified to meet growing needs, but the frequencies still remained allocated in comparatively wide bands which were shared among various classes of services. This led to crowding in the case of mobile bands the frequencies of which were shared by marine and aircraft services, notwithstanding the fact that the types of apparatus practicable for these very different vessels vary largely in size and weight and consequently in their technical characteristics. At Cairo further efforts were made to facilitate the solution of the problem of the expansion of the aeronautical services by specifying exclusive bands of frequencies to the various aircraft routes at present in contemplation.

The addition of the *Queen Mary* to the mercantile marine has been a milestone from the radio engineer's point of view. This ship is designed to meet the special requirements of vessels of her class for which it will serve as a model. Developments of the direction-finding services have been continuously taking place, especially in Adcock direction-finders. The study of traffic requirements and the development of engineering and organization methods hand-in-hand have enabled excellent services from an economical point of view between many points on the earth's surface to be found. Printing telegraph methods employed in submarine cable telegraphy are now also employed for radio purposes. The approach of the next sunspot maximum has enabled the P.O. engineers to provide additional plant and aerials so as to meet the anticipated adverse conditions such as frequency 'wobbling'. In ionospheric investigations, important theoretical and experimental discoveries have been made. Mr. Rickard concludes by discussing vacuum tubes and high-frequency cables which can now be constructed so as to be semi-flexible.

TYŌKŌ AND HIS SEISMOSCOPE

A. IMAMURA has recently translated relevant passages concerning the life of Tyōkō and his seismoscope from the Chinese history "Gokanzyo" and discusses this very interesting topic[1].

Tyōkō was born in A.D. 78 in Si-o, Nan-yang Province, China, during the later period of the Post-Han dynasty, and held during his life several important governmental posts including that of the director of the Bureau of Almanac and History during A.D. 115–121, and A.D. 126–133. He was an excellent astronomer and a great literary man, and one of his duties besides constructing almanacs and writing history was to record the great events which happened in the country. About that time, parts of China were seismically active, which may account for his interest in seismology. He is said to have invented, in addition to his seismoscope, an instrument resembling in some respects the modern theodolite, a clock, a tricycle, and a so-called self-flying bird.

In the original Chinese history the seismoscope is not figured but only described. J. Milne in his "Earthquakes and Other Earth Movements" reconstructed a figure and gave a description. Imamura corrects some parts of Milne's figure and description and also comments on interpretations by Mr. Wang Chen-to and Mr. T. Hagiwara, and on a seismoscope constructed by himself.

Tyōkō's seismoscope consisted of a pendulum device which caused a copper ball to fall out of one of eight dragon's heads into the mouth of a waiting toad, according to the direction of the epicentre of the shock. Imamura states that the central pillar was in all probability an inverted pendulum, that no record of the earthquake was made by the instrument, that only one ball dropped at each earthquake, and fell into the mouth of a toad, not a frog. In the original description the dimension of the diameter of the supporting barrel was given as 8 units. Imamura states that the unit mentioned was likely to have been one third of a foot whereas Milne took it to be a foot.

Tyōkō's seismoscope, invented in A.D. 132, probably being the first seismological instrument, will rank equal with his theodolite in scientific achievement, and points him out as having been a man of genius. He died in A.D. 139 at the age of sixty-two years.

[1] *Jap. J. Astro. and Geophys.*, **16**, Nos. 2–3 (1939).

ELECTRICAL PROGRESS IN POLAND

IN the *Electrical Times* of August 3, A. G. Moss describes the rapid and confident way in which Poland is developing hydro-electric power schemes within her boundaries on a long-term basis, and having obviously the utmost confidence in the future. In Great Britain, on the other hand, the tendency at present seems to be to limit financial forecasts to the next few uncertain months due to possibilities of war.

In a recent tour through Poland, Mr. Moss saw the many plans which are being carried out for harnessing the various sources of industrial power in the country for the benefit of the national economic system. Although primarily an agricultural country, Poland was the last of the great European powers to utilize their native fuel and water-power; but now, for about the last twenty years, rapid progress has been made and this notwithstanding the crippling financial burden which the Polish army and arms production has, of necessity, laid on the country during this period.

Poland's power resources consist of great coalfields in the Silesia, Krakow and Dabrowa regions in the south-west. In addition there is hydro-electric power distributed along the rivers of the Carpathian foothills, and, a little farther north, vast fields of natural gas which are easily tapped for direct supply for domestic and industrial use. The presence of these three sources of power might have led, as in other countries, to harmful commercial competition between those specially interested in them. In Poland it was considered that electrical power was much the most desirable.

The Polish Government is therefore considering electrification on a national basis within the next few years. This presents difficulties when we remember that nearly 70 per cent of the population is agricultural and lives at a low peasant standard. Nevertheless, in spite of these serious difficulties, it is going ahead very energetically with this end in view.

In some parts of south Poland, natural gas is tapped straight from fields into the home at a very low cost to the consumer. In some cases, street lamps are left on all day as it is cheaper to let them burn than to pay a man to put them out. Considered from the national point of view, the Government has decided that electricity is the most economical method to use. In an official document published in Warsaw a few weeks ago it is stated "The Polish Republic and the Polish Government fully realize that backwardness in electrification must be made good in the very near future in order to enable due progress to be made by the whole economic life of the country".

The average increase in the electrical output over the last six years amounts to nearly forty per cent. In Belgium the corresponding percentage is 33, and in France 22. It has to be remembered that Poland only recovered its present independence in 1919, and spent the next two years defending it. This increased demand for electricity has already necessitated large-scale extensions to the Polish high-tension zone grid systems and also the construction of a considerable number of new electric power stations.

SCIENCE NEWS A CENTURY AGO

Daguerre's Discovery Described

ON August 19, 1839, Arago at a meeting of the Paris Academy of Sciences "in the presence of a crowded audience, which had besieged the doors of the Institute three hours before the commencement of the sitting, divulged the secret of M. Daguerre's invention, which has now, as you are all aware, become public property. Three drawings having been exhibited by way of Specimens, M. Arago began by capitulating the discoveries—or rather hints towards discoveries, of former chemists; he afterwards dwelt upon the progressive experiments of M. Niepce since carried out by M. Daguerre. . . ." After dealing with Daguerre's process Arago proceeded "to speculate upon the improvements which this beautiful application of optics was capable. . . . The question arose, too, whether it will be possible to take portraits by this method. M. Arago was disposed to answer in the affirmative.

"In physics, M. Arago indicated some of the more immediate applications of Daguerreotype. . . . He instanced some of the complex phenomena exhibited by the solar spectrum. We know, for example, that the different coloured rays are separated by black transversal lines, indicating the absence of these rays at certain parts; and the question arises whether there are also similar interruptions in the continuity of the chemical rays? M. Arago proposes as a simple solution of this question, to expose one of M. Daguerre's prepared plates to the action of a spectrum; an experiment which will prove whether the action of these rays is continuous or interrupted by blank spaces" (*Athenæum*, Aug. 24, 1839).

Completion of Pulkowa Observatory

THE earliest observatory in Russia was built at St. Petersburg in 1725, under the auspices of Peter the Great, and the French astronomer J. N. Delisle (1688–1768) was made director. This observatory was burnt down in 1747, but though reconstructed it remained of minor importance. In 1827 the Academy of Sciences put forward the idea of a new central observatory and three years later the Emperor Nicholas declared through his minister, "that the honour of the country appeared to him to demand the establishment, near the capital, of a new astronomical observatory, conformable to the actual state of the science, and capable of contributing to its ulterior advancement." A site was chosen at Pulkowa, about twelve miles south-west of St. Petersburg, and Fredrick Georg Wilhelm Struve (1793–1864), the director of the Dorpat Observatory, was appointed to superintend the erection of the observatory. "The design of the establishment was upon a scale of unprecedented magnificence. The foundation stone of the building was laid on the 21st of June 1835, and it was finally completed on the 19th of August 1839" (Grant). The instruments installed included a vertical circle and a transit instrument by Ertel, of Munich, a meridian circle and a prime vertical telescope by the Repsolds, of Hamburg, and an equatorial telescope by Merz and Mahler, of Munich. Struve began his observations in September, having among his earliest assistants his son Otto and C. A. F. Peters (1806–80). From its formation the Observatory took a lead in the exact measurements relating to the motion of the earth and the positions of the

principal stars, and it was once called "the astronomical capital of the world". The elder Struve retiring in 1861, he was succeeded in the directorship by his son Otto Wilhelm von Struve (1819–1905) and among his successors have been Theodor Alexandrovitch Bredichin (1831–1904) and Johan Oscar Backlund (1846–1916).

The British Association at Birmingham

OWING to the Chartist riots in Birmingham in July 1839, doubts were expressed as to the advisability of holding the meeting of the British Association, but the meeting took place and was successful. On August 24 the correspondent of the *Athenæum* wrote: "Many circumstances combined to throw a gloom over the opening of the Birmingham session of the British Association. The recent disturbances had rendered it doubtful whether the meeting might not be adjourned to another time and place; foreigners were alarmed by the exaggerated accounts of the riots; and the members of the Local Committee, having their attention engaged by the exciting events around them, could not bestow much of their time in preparations for the reception of the Association. Indeed, under the circumstances, it was surprising that their arrangements were so perfect as we found them. Many members, however, were disappointed at the very limited number of manufactories opened to general inspection; and it was thought to be most strange, and a subject of general remark, that no one of the great engineering establishments, for which Birmingham is so renowned, were found in the list. The Local Committee, however, and all who aided them, deserve great credit for their exertions in collecting together the 'Illustrations of Manufactures, Inventions and Models'."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN MECHANICAL ENGINEERING at the Hull Municipal Technical College—The Director of Education, Guildhall, Hull (August 22).

DEMONSTRATOR IN BOTANY—The Secretary, King's College, Strand, W.C.2 (August 26).

ASSISTANTS II (Male) in the Meteorological Office—The Under-Secretary of State (S.2.B.Met.), Air Ministry, Adastral House, Kingsway, W.C.2 (August 28).

MASTER TO TEACH MATHEMATICS in the Government Technical School, Baghdad—The Secretary (I.P.R/CA), Board of Education, Alexandra House, Kingsway, W.C.2 (August 28).

A SENIOR SCIENTIFIC OFFICER, A JUNIOR SCIENTIFIC OFFICER, AND AN ASSISTANT I, in the staff for Scientific Research—The Ministry of Supply, Adelphi, W.C.2 (quoting Appts. No. 03/S.E.3) (August 31).

ASSISTANT PROFESSOR OF SOCIOLOGY in the Fuad el Awal University—The Dean of the Faculty of Arts, Giza, Egypt (September 1).

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